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COUNTRY USSR

REPORT

SUBJECT English Translation of MIG-21F-13 Aircraft Manual Entitled Instructions on Technical Operation and Maintenance, Operation of the Armament

DATE DISTR. 15 July 19 50X1-HUM

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The MIG-21F-13 Aircraft

Instructions on Technical Operation

and Maintenance

(Instruction No. GK-021B)

Book Two

Operation of Armament

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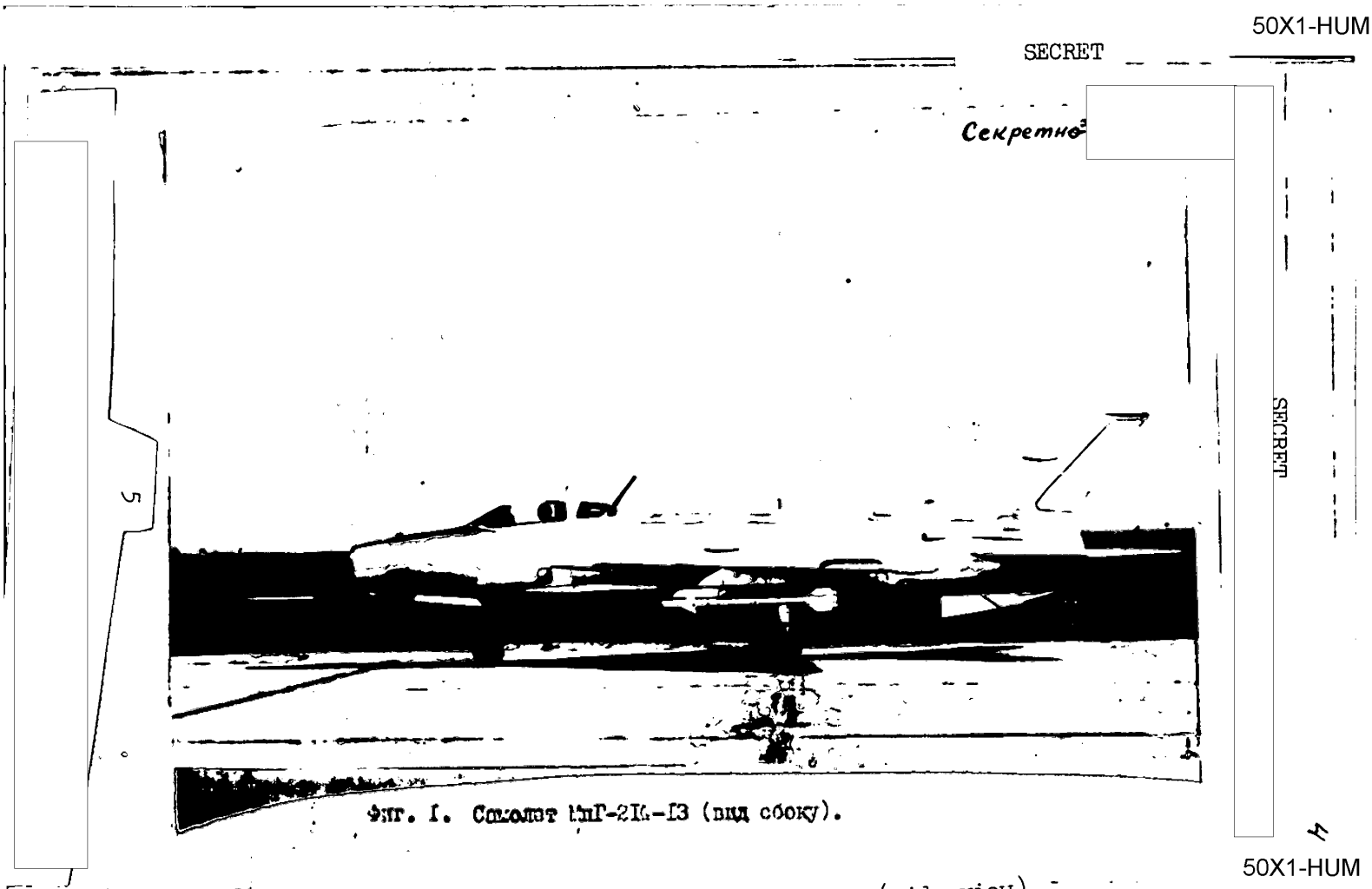

Фиг. 1. Самолет МиГ-21К-13 (вид сбоку).

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Fig. 1. The MIG-21F-13 Aircraft (side view)

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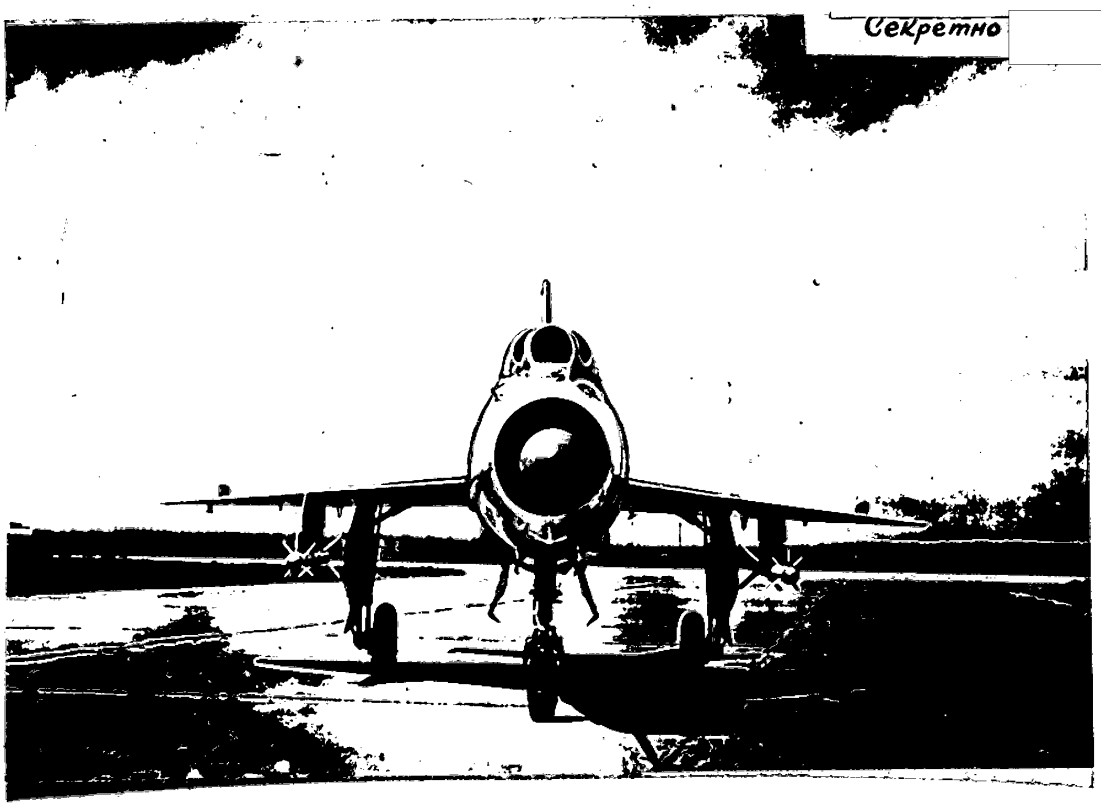

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Фиг. 2. Самолет МиГ-21[illegible]-13 (вид спереди).

Fig. 2. The MIG-21F-13 (front view)

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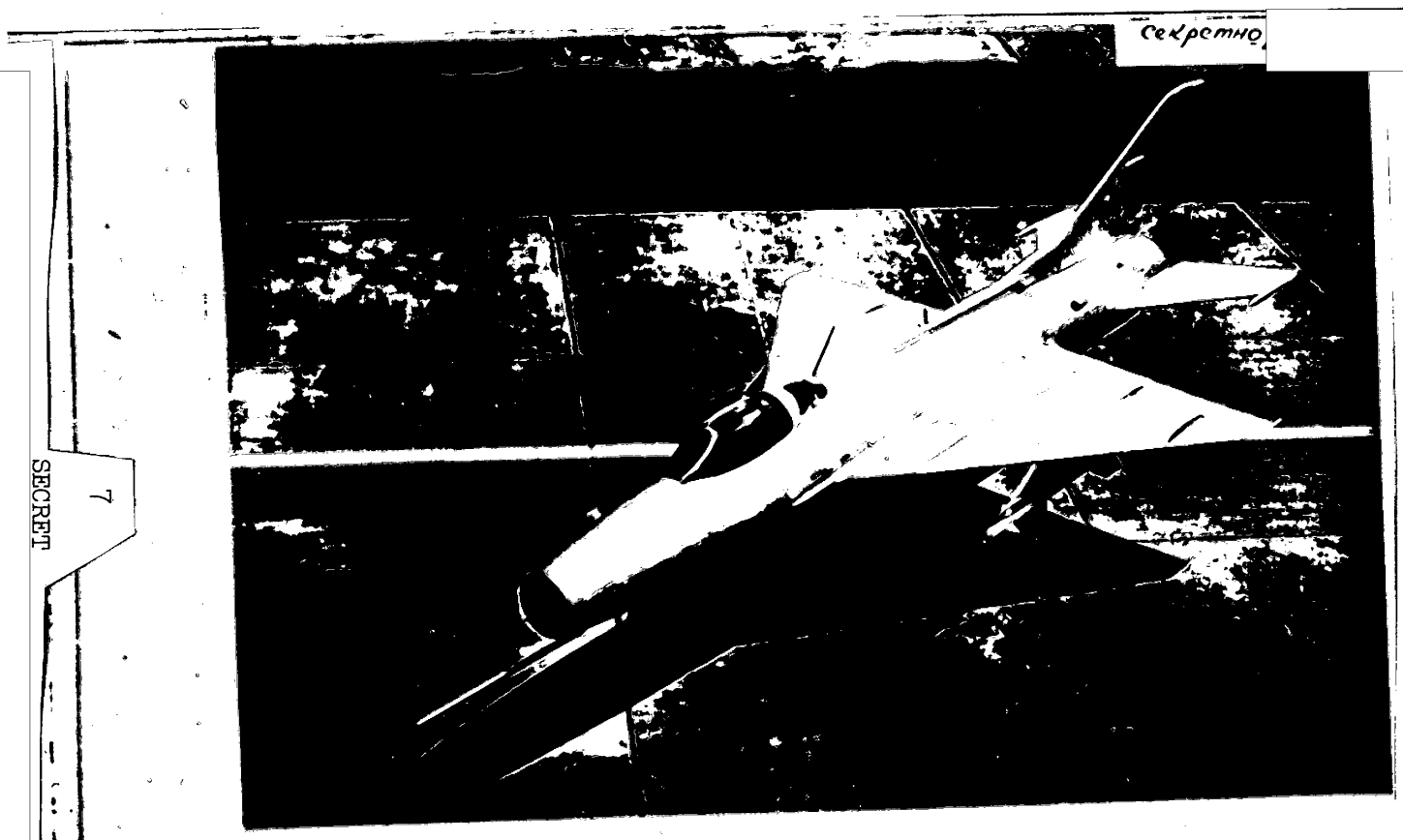

Фиг. 3. Самолет МиГ-21Ф-13 (вид 3/4 сверху спереди).

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Fig. 3. The MIG-21F Aircraft (3/4 front top view)

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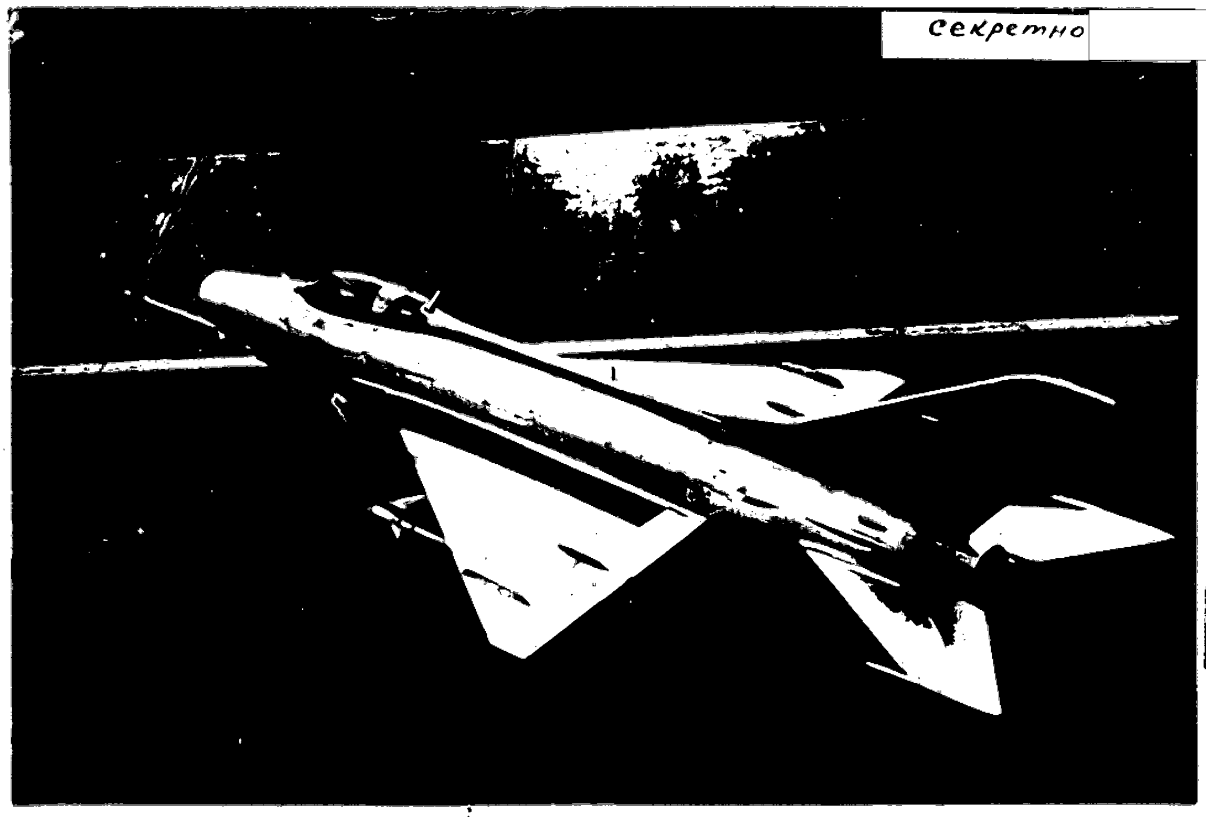

Фиг. 4. Самолет МиГ-21Ф-13 (вид 3/4 сзади сверху).

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Fig. 4. The MIG-21F-13 Aircraft (3/4 top rear view)

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INTRODUCTION

The MIG-21F-13 (Figs. 1-4) is a single-seat, light, day and night fighter having high performance characteristics and armed with artillery, rocket and missile-type weapons. The aircraft is designed for flights under combat conditions at supersonic speeds and high altitudes.

Weapons variations, suspended from the aircraft (Fig 5), make it useful for a variety of combat missions.

Basic armament of the aircraft is a system of K-13 "air-to-air" class homing type missiles.

Artillery armament consists of one NR-30 cannon having a combat load of 60 rounds.

The cartridge belt is located in a circular magazine placed between the outer fuselage skin and the fuel tank skin.

To prevent the possibility of formation of an explosive concentration of powder gases during firing the barrel fairing and hatch cover have louvers to provide for in-flight exhause of these gases from the gun compartment.

Rocket armament permits attachment of two UB-16-57U pods, each containing 16 S-5M or S-5K rockets.

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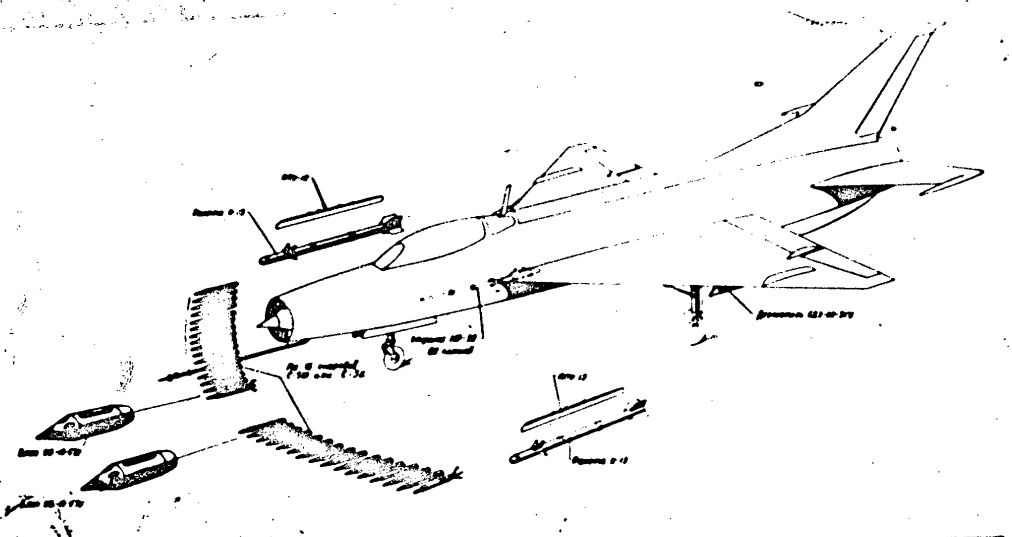

Fig. 5. Weapons variations

Фиг. 5. Варианты боевых средств.

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The pods are suspended in place of the homing type K-13 missile under [10] the BDZ-60-21U wing pylons.

To conduct aimed firing from the cannon and the rocket pods and to launch the homing missile, the aircraft has installed on it an automatic sight ASP-5ND with a range only radar SRD-5MK and a sensor for attack and slip angle DUAS-8M, enabling high accuracy for firing unguided rockets.

The aircraft is equipped with an infra-red viewfinder SIV-52 for aimed firing at night.

The quality of aiming and the firing results are checked by a gun camera SM-45-I-100-OS with a timing mechanism VM-2. The gun camera is mounted in the place of the SIV-52.

The homing missile system permits the carrying and launching of two K-13 missiles.

The missiles are suspended from the VDZ-60-21U wing pylons with the aid of special launching devices APU-13.

The K-13 homing missile is designed for destruction of target day or night under ordinary weather conditions at any operating speed and at all flight altitudes of the fighter plane.

The use of homing missiles under dynamic ceiling flight conditions considerably increases the height of combat application and possibilities of target destruction at high altitudes.

The SRD-5MK radar, together with the permissible range computer VRD-2A, [11] included in the armament system of the aircraft, determines the maximum permissible launching range for the K-13 missile and signals the range for withdrawal from attack.

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The permissible launch range of the missile is determined by the pilot by ignition of a permissible range light.

The ASP-5ND sight is used like an ordinary collimator viewfinder during missile launching.

The homing of the missile on its target is accomplished by control apparatus, consisting of a TGS-K13 passive infra-red homing head and a steering drive.

Target lock-on by the homing head is monitored by the pilot by means of an audio signal.

Suitable signaling apparatus on the aircraft implements checking the combat readiness of the cannon, the initial position of the control devices, for firing the rocket, and the presence of either the missiles on the launching frame or the rocket pods on the wing pylons.

Provision is made for emergency jettisoning of launching apparatus APU-13 or the rocket pods, emergency launching of the missiles, and the blocking of accidental jettisoning.

Firing of the rocket pods and missile launching are blocked if the forward landing gear strut is not in retracted position. The MIG-21F-13 aircraft is relatively simple in operation and is accessible to both flight and maintenance personnel having suitable training in the operation of supersonic jet fighter planes rigged with modern types of artillery, rocket and homing-type weapons.

Air and ground crews must understand clearly that a modern fighter plane [12] flying at great supersonic speeds, requires full knowledge of the aircraft and its armament systems.

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The required understanding of the armament systems and their maintenance, as well as a sufficient knowledge of work related to pre-flight and preliminary preparation, will always assure dependable functioning of the armament.

Servicing of the MIG-21F-13 aircraft is permitted only by technical and maintenance personnel, only after passing examinations.

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[13]

PART I

PREPARATION OF ARMAMENT FOR USE

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CHAPTER I

[14]

1. PRELIMINARY PREPARATION

I. General Remarks

Preliminary preparation is the basic form of preparation of the aircraft's armament for flight. Well carried out, it assures keeping the armament in constant readiness.

Preliminary preparation includes:

a) Post-flight examination of the armament aggregates and checking their functioning;

b) Elimination of defects detected during flight or post-flight examination;

v) Removal of unexpended missiles from the launching mechanisms, unloading of the UB-16-57U rocket pods, unloading of cannons and gun camera.

Work should begin by removing unexpended ammunition, first being sure that all breakers in the armament control circuit and the battery are disconnected.

Armament preparation is considered complete when the post-flight inspection has been made, the functioning of aggregates has been checked, and observed defects have been eliminated.

2. INSTRUCTIONS ON REMOVAL OF UNEXPENDED AMMUNITION

[15]

Detection causes of failure and the removal of unexpended ammunition following combat missions are conducted at points as specified per operating instructions of the airdrome.

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In carrying out work on unloading of unexpended ammunition, it is necessary to strictly observe established procedures and safety measures.

The procedures for removing various types of unexpended ammunitions from the aircraft are presented in the appropriate parts of these instructions (Part II).

Unloading Ammunition From the Cannons

Cannon ammunition is unloaded in case of:

1. Replacement with new cartridges,
2. Preparing aircraft for practice firing,
3. Refilling to replace expended cartridges,
4. Cleaning,
5. Elimination of failures,
6. Remaining unexpended cartridges loaded for practice firing.

During storage of the unit on the aircraft, the movable portions of the cannon must be located in the forward position. Final loading of the cannon for firing is permissible only by the pilot, in the air, by reloading.

On completion of firing and before landing, the Circuit breaker "Pushka" [16] [cannon] must be disconnected, because in the event of incomplete firing, a live cartridge remains in the firing chamber. When the movable parts are located in the forward position before landing, the cannon should be reloaded.

Removal of left-over ammunition after use of the armament should be carried out only after the cannon has been unloaded.

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Unloading of Rocket Pods

Unloading of rocket pods is conducted in case of:

1. Cancelled flight,

2. Change in flight mission,

3. Detection of any failure in the signal, suspension, or fire control systems,

4. Return with unexpended rounds.

Before landing the aircraft after firing from the pods, circuit breaker "RS" should be disconnected.

Removal of loaded pods of rockets from the aircraft is forbidden. Before removal, the pods must be unloaded.

In the event of long periods of non-use, the rocket pods (launching mechanisms) should be removed from the aircraft, and the DZ-57 locks should be opened.

Removal of Unfired Missiles

[17]

Unfired missiles are removed:

1. For change in flight mission,

2. On detection of any failures in the signal, suspension, or launch-control systems,

3. For position rechecking during preliminary preparation after an established number of landings and storage time of suspended missiles on the aircraft.

Before landing an aircraft with unfired missiles, it is necessary to disconnect circuit breaker "Pusk SS"[/"launch SS"/]. "Glow SS", and "heat SS" breakers are to be disconnected only after taxiing the aircraft to its

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parking place.

3. POST-FLIGHT INSPECTION AND PREPARATION OF ARMAMENT SYSTEMS (Fig 6)

Post-flight inspection of armament is the basic form of inspection and is conducted for the purpose of careful checking of armament, and detection of failures and damage which could have occurred during flight.

Inspection of armament aggregates after completion of flights should be undertaken only after removal of unfired ammunition from the aircraft.

The amount of work for inspection depends on the type of armament used.

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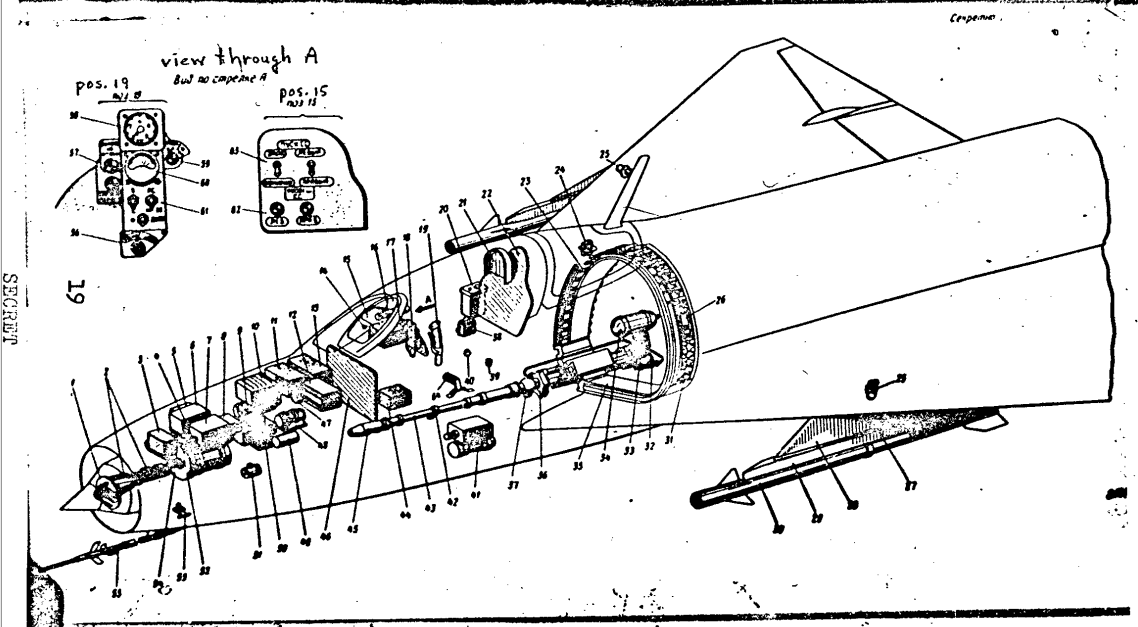

Fig. 6. Locations of armament in aircraft (basic variation)

Фиг. 6. Размещение вооружения на самолете (в основном варианте).

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Fig. 6 Location of Armaments in the Aircraft [19]

(Basic Variation)

1. Range only radar combined broad- and narrow-beam antenna;
2. Waveguide channel;
3. Null-type sighting gyroscope ASP-5ND;
4. Control plug for SRD;
5. SRD Control panel;
6. SRD; range only radar receiver unit SRD;
7. Power pack for SRD;
8. SRD comparator unit;
9. Sight computer ASP-5ND;
10. Transformer PO-500A;
11. Null sighting gyroscope amplifier;
12. Sight control box;
13. Sight electronic relay unit;
14. Button for emergency launching of K-13 missiles;
15. Upper right instrument panel;
16. Device for observing infra-red viewfinder SIV-52;
17. Sight head ASP-5ND;
18. Bracket and panel with sight switches;
19. Firing and launching control button, and button for sight damping on control stick of aircraft;
20. Power pack for SIV-52 viewfinder;
21. Armored headrest on seat;
22. Armor plate, rear;

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23. Cartridge belt;

24. Overload sensor MP-28A;

25. Control device PVS-36D for launching unguided rockets RS;

26. Cartridge belt connector;

27. Intermediate beam;

28. Beam pylon BDZ-60-21U

29. Launching mechanism APU-13;

30. K-13 missile;

31. Linked cartridge belt;

32. Electropneumatic valve EK-48;

33. Rear cannon mounting;

34. Compressed air tank (1.8 liters);

35. Cartridge belt guide;

36. Front cannon mounting; [20]

37. Gas port;

38. F-14 A filter in sight power supply circuit;

39. Switch for operation of range only radar and missile launching and firing systems, marked "RS, cannon-SS";

40. Volume control for audio signal for K-13 missile;

41. Transformer PO-750A;

42. Supplementary mounting for cannon barrel;

43. NR-30 cannon;

44. Voltage Regulator for ASP-5ND sight;

45. Gas compensator;

46. Armor plate, forward;

47. Altitude mechanism for ASP-5ND sight;

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48. Permissible range computer VPD-2A;

49. Air speed sensor DVS;

50. Transformer PT-500Ts;

51. Altitude indicator VS-14500;

52. Range only radar speed unit;

53. Temperature indicator P-5;

54. range only radar transmitter receiving;

55. Sensor for angles of attack and slip DUAS-8M;

56. Target break-off button;

57. Signal lights for overload and pull-out of attack for K-13 system;

58. Range indicator UD-1;

59. Signal light for permissible launch range of K-13 missiles;

60. Range indicator for ASP-5ND sight;

61. Sight selector switch;

62. Signal lights to indicate presence of suspended K-13 missiles;

63. Launch control switch for K-13;

64. Potentiometer for manual control of sight range.

In cases where no changes in types of suspension on the aircraft are anticipated between successive flights, those armament aggregates which were used in the course of the flight day should be examined and checked for operability. [21]

During examination, special attention should be paid to:

(a) Those aggregates whose operation was abnormal or doubtful in the pilot's opinion;

(b) Those parts and aggregates which were damaged in fulfilling the

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mission;

(c) Those parts and aggregates subjected to the greatest wear.

Ground crews carrying out the post-flight inspections should undertake elimination of failures only after completion of the inspection.

To maintain the rest of the armament complex in a state of constant combat readiness, inspection and checking of the operability of aggregates not used in a given flight are carried out during routine maintenance on a calender schedule. In carrying out preliminary preparations, all operations must be executed which will assure complete dependability and readiness of armament for combat in the least possible time and preflight preparations.

INSPECTION OF ARMAMENT AGGREGATES IN THE COCKPIT [22]

In inspecting armament aggregates in the cockpit of the aircraft, the following should be checked:

1. The absence of mechanical failures, clarity of markings, and securing of the automatic alarm system installed for armament control purposes, in "on" and "off" positions. Checking is conducted by visual inspection with the battery disconnected.

2. The condition of the fire button on the control stick of the aircraft and the condition of the buttons for emergency missile launching, emergency jettisoning of suspensions on wing pylons and emergency jettisoning of belly fuel tank. The buttons should be free of cracks and projections. The buttons should fit into their housings without jamming and should have clear color.

3. Smoothness of shifting and dependability of position of fire variation of the rockets in the positions "1 Salvo", "2 Salvo", "Automatic".

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4. Dependability of operating position setting of switches for launch variation and correction of volume control of the audio signal coming to the pilot's helmet from the missiles.

5. The presence and fidelity of all signal lights of the armament control system.

6. Dependability of support for gun camera, the condition of those parts which are accessible for inspection without dismantling, and the gun camera's performance.

7. External condition of the parts of the head, mounting the sight bracket, and general performance from the off-base range only radar. (Fig. 7)

8. Performance of the sight from the range only radar.

9. Accuracy of alignment of camera gun reticule with central point of sight grid.

10. External condition and performance of SIV-52.

11. Condition of cannon fire control and reloading circuits.

12. Condition of fire-control circuits for rocket pods or missile launching.

After checking the overall performance of the sight equipment and the condition of the weapons control systems, the battery and circuit breaker are disconnected.

The elements of a weapons system are checked in the cockpit of the aircraft at the same time that the weapons system control circuits are checked.

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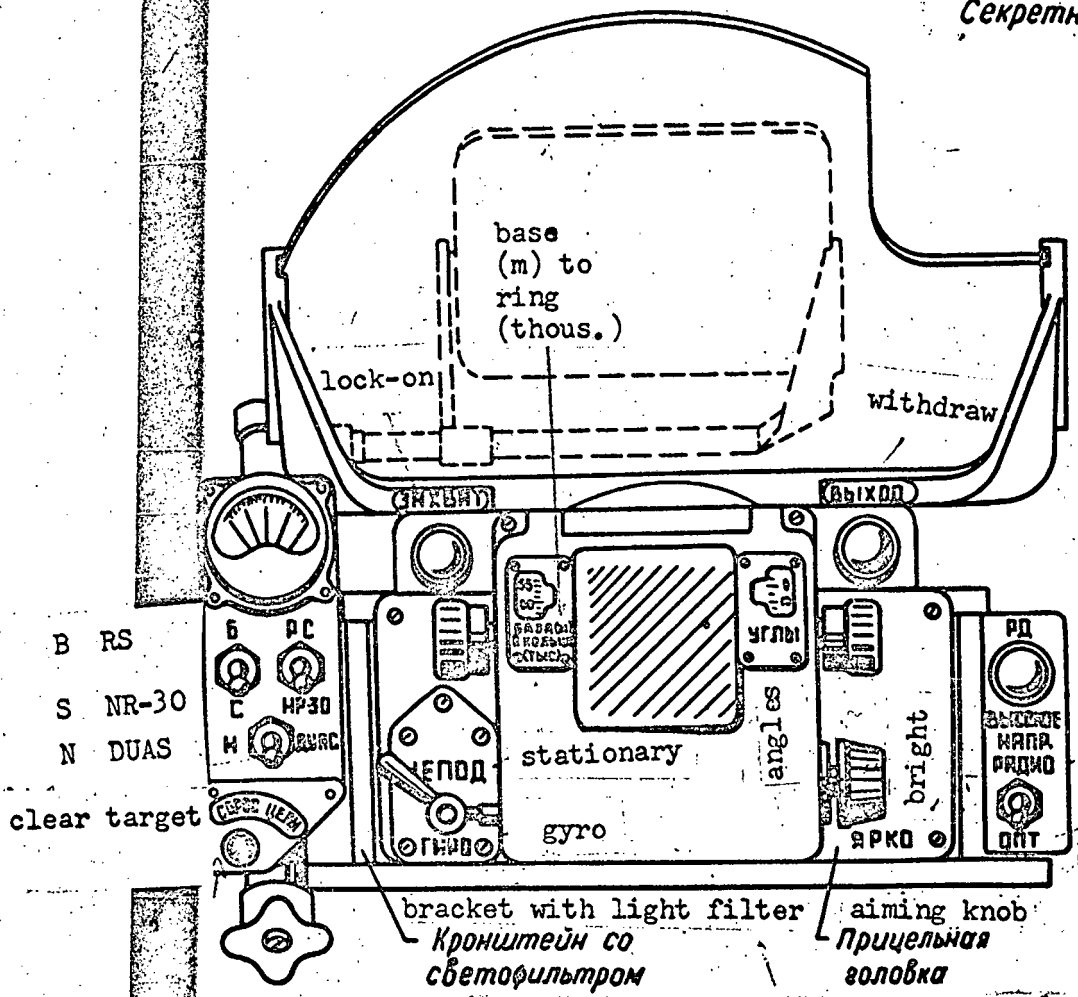

Рис. 7. Установка переключателей и сигнальных ламп на кронштейне и головке прицела.

Fig. 7. Installation of switches and signal lights on the bracket and the aiming knob.

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INSPECTION OF THE GUNNERY SYSTEM

1. Check the condition and dependability of the fastening for the cannon compartment cover and the barrel cowling.

2. Examine the threads on the forward tie-down turnbuckle and its nut. The threads should be free of dents and cuts. The chains for the safety pins should not have any breaks in them.

Check the condition and dependability of the forward cannon-to-fuselage fastening.

The nuts on the bolts should be tightened all the way and locked.

3. Check the condition and dependability of the rear cannon-to-frame fastening. [25]

There should be no play in the rear mounting. Check the safety pin and seal on the eccentric and kingpin fastening stem.

4. Check the condition and dependability of the yoke fastenings on the barrel bracket. The fastening brackets on the yokes should not show any mechanical damage.

The nuts on the spindles should be secured with pins. The marine bolts should have correcting rings and stopper pins.

The space between the barrel and the inside diameter of the ring must be uniform all around. Contact of the barrel with the ring bracket is not permitted.

The space between the barrel and the yoke collar must not be less than 0.3 millimeters.

5. Inspect the units of the pheumatic system for cannon reloading. Check for air leaks.

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Pay special attention to the condition of the check valve in the forward mount and the tube connections.

The air tubes should not have any cracks or other defects.

The [illegible] nuts should be tightened down and locked with wire.

The manual reloading lever Zh-18 should be easily moved by hand and should snap back to its original position when released. [26]

Examine the air tank and its fastenings. The tank should not have any dents or other mechanical defects.

6. Check the condition of the wiring.

During the check, be sure there is no worn insulation or damaged braiding on the wires.

Check plug connectors for reliability.

All plug-type connectors must be secured with safety wire. The angular cap in the electric trigger must be dependably secured with a pin. If defects are observed, the electric wiring must be checked with the wiring diagram.

7. Inspect the feed track. In places where joints of the guide profiles butt against the movable feed track sleeve, there should be no opposing steps in either direction of the belt travel, nor should there be any hindrances such as: rivets, projection of other parts, etc.

Clearance gaps between parts of the cannon receiver mechanism and the feed track should be 5 plus or minus 2 millimeters.

All in the feed track rods should be capable of being inserted by hand with minimum effort.

8. Check that the cartridge ejector does not have any cracks, deformations, or other defects.

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9. Inspect the fastening on the gas exhaust. Remove the gas exhaust housing and check the condition of the lock on the gas compensator bushing. [illegible] bushing of the gas compensator should not [illegible] housing of the barrel.

10. Inspect the cannon. [27]

The inspection is carried out by aggregate. When examining mechanisms and individual parts, be convinced of their working conditions. Check for existence of cracks, dents, tears, and wear.

The inspection is carried out in accordance with instructions on the operation of the cannon.

11. After inspection and cleaning, install the cannon, test the reload system and fire control, charge the fire units, and install the fairing and covers of the cannon compartment.

PREPARATION OF THE HOMING MISSILE SYSTEMS

The following is required to prepare the homing missile systems for operation:

1. Clean and visually inspect the wing pylons and launch mechanisms. Check for the absence of breaks, cracks, dents, and tears on the suspension system parts. Check the housing fastenings and the condition of the rubber gasket on the pylon.

2. Check the condition of the fastenings of the wing pylons to the wing parts and the locks in the pylons, the condition of the electrical connections, front and rear supports, the condition of the housing fastenings, the hatch covers for the suspension kingpin and hatch covers for the plug connectors.

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3. Remove the launch mechanism and check the cycling of the DZ57 locks by the emergency jettisoning electrical system.

NOTE: Inspection of the functioning of lock DZ-57 by removing APU-13 is carried out depending on climatic conditions, intensity of use, and in carrying out scheduled maintenance. [28]

4. Check the reliability of lock DZ-57 through the inspection windows of the wing pylons.

5. Clean and inspect APU-13.

During inspection, check the following:

(a) Condition of the plug connector;

(b) Condition of the point contact;

(c) Absence of dents on the leads;

(d) Condition and functioning of the stop catch and vibration damper;

(e) Condition of the stops and suspension lugs;

(f) Condition of the fastening on the forward cowling and bracket secured to the cross joint;

(g) Tightness of the APU-13 suspension lug on the DZ-57 lock with the aid of a torsion wrench.

6. Measure the missile launch force from the launch mechanism with the aid of a ZUS-13 device. This should be done no less than once every ten launchings.

7. Examine and check the operation of the sight equipment.

8. Examine the switches, circuit breakers and other aggregates of the armament control system in the cockpit.

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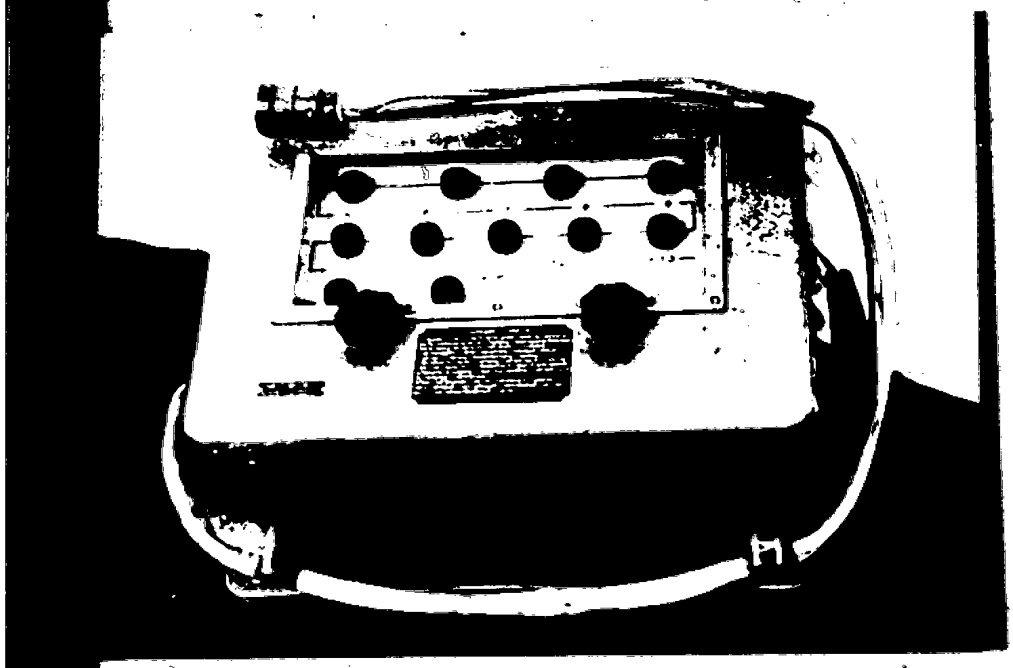

Фиг. 8. Общий вид имитатора ИЛ-13А.

Fig. 8. General view of simulator II-13A.

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9. Check the functioning of the power circuits, launch, and operation control systems with the aid of an II-13A panel. (Fig 8)

If the wing pylons were previously prepared for suspension of rockets, [30] then the following is required at the beginning of the preparation:

(a) Remove from the wing pylons, the detainers used for suspending the rocket pods.

(b) Install detainers on the pylons designated for suspending the APU-13;

(c) Check the functioning of DZ-57 lock, examine and install the launching mechanism, and carry out the remaining recommendations on preparation of homing missiles.

PREPARATION OF ROCKET ARMAMENT

The following is required in preparing it for use:

1. Carry out visual inspection of the wing pylons and check for the following:

(a) Cleaniness of the pylon pods and DZ-57 lock;

(b) Condition of the wing pylon fastenings and locks;

(c) Check whether the hatch cover which allows access to the retaining pin for fastening the pylon to the wing, the locks of the access hatches, and the lock which fastens the aft mount are closed properly.

2. Remove the retainers from the wing pylons used for attaching the APU-13.

3. Install lugs on the wing pylon at point 120 forward and 106 aft.

4. Check the operation of lock DZ-57 for mechanical release.

5. Check the condition of lock DZ-57 of the emergency jettisoning system,

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the condition of the emergency jettisoning locking, and the suspension lights. [31]

6. Close the wing pylon lock, suspend the rocket pod and connect the small plug connector.

Before suspending the pods, (Fig 9), it is necessary to unpack them and visually examine and check the smoothness of the lug movement.

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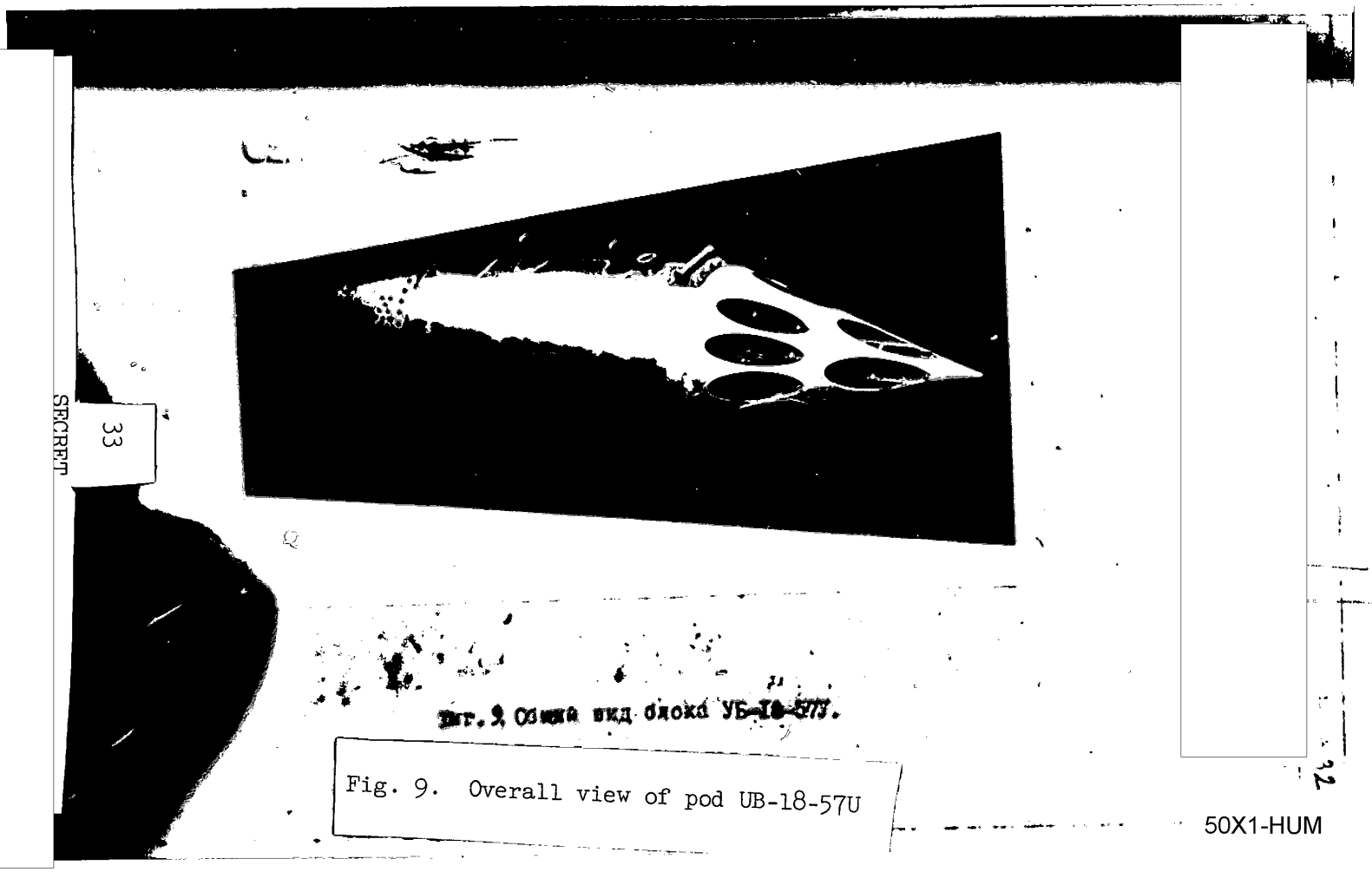

Фиг. 9. Общ вид блока УБ-18-57У.

Fig. 9. Overall view of pod UB-18-57U

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7. Check the aiming accuracy with the aid of a TKP on a moving target. This is carried out with the first suspension. To simplify this work, the lugs and rocket pods fasten to the wing pylon behind it [TKP].

NOTE: This entire operation is also carried out in the event that the wing pylons were used to suspend APU-13 previously.

8. Make sure that there are no rockets in the pod barrels.

In the event of incomplete firing, unload the pod.

9. Remove the rear fairing of the pod, remove the retainers from the barrels and remove the rocket caps containing the charging cord from the catches.

Removal of the pods is accomplished with a reamer, with simultaneous cleaning of the barrels from scale.

10. Make a visual inspection of the pod, clean the pylon, the barrels, and the rear fairing of scale and lubricate them. When examining the pod, check the following:

[33]

a) The absence of breaks, cracks, bends and dents interfering with the operation of the pod;

b) The condition and reliability of the barrel fastenings in the pod housing. The barrels should not have any hollows, bulges, dents, or gaps.

v) The reliability of the fastenings on the housing skin and the condition of the catches on the rear fairing.

Rocket pods having serious defects, should be sent to the shop for repair.

Under airfield conditions, it is permissible to remove burrs with a smoothing file -- remove projections without filing any of the base metal.

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Small hollows in the pod skin, which do not interfere with the functioning of its mechanisms, are left alone.

In the case of prolonged periods without use, the ricket pods must be removed from the aircraft and stored.

11. Remove the rear pod fairing, and with the aid of a tester, check the voltage putput on the contact sockets for the plugs from the rocket wires.

After checking, install the PUS-36D in the zero position, which is determined by the ignition of a signal light, and then disconnected the power supply.

Chapter II [34]

PREFLIGHT PREPARATIONS OF ARMAMENT

1. General Remarks

Preflight preparation of the armament is carried out immediately before a given flight.

The amount of preparation of the aircraft's ammament for flight depends on the nature of the flight mission and the degree of readiness of the armament for use.

Depending on the mission of the aircraft, preflight preparation is carried out on the sight and photomonitoring equipment, the cannon armament, and the homing missile or rocket systems.

Only those operations which must be performed on all the aircraft armament in preparing it for combat and listed in this chapter.

To expedite preflight preparation of the aircraft, an entire series of steps should be carried out beforehand. For example, if preflight preparation of the armament is carried out immediately after preliminary preparation,

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then a secondary check of the functioning of the aggregates and armament control systems is not necessary.

In each case, the extent of preflight preparation should be determined by the armament engineer by taking into account the length of time elapsed since conducting preliminary preparations, the storage conditions of the armament and the experience of his maintenance crew.

Actually, preflight preparation of the armament should only include checking the condition of the control and the combat armament circuits of the aircraft.

In preparing the armament for flight, the work begins by checking the overall functioning of the sighting equipment and testing the armament aggregate control systems from the cockpit of the aircraft, and only then starting the magazine loading.

Checking of the armament control circuit should only be done from a ground source of electrical energy.

Note: It is forbidden to load the cannon, the rocket pods, and missile suspension, while the engine is running and while anyone is in the cockpit of the aircraft.

In all cases, the following is required before starting the preparation:

1. Open the cockpit canopy of the aircraft. After raising it, insert the ground stops in the holes in the pistons of the canopy lift.

2. Check the installation of the safety pins in the catapult seat and the automatic canopy ejection handle.

Remove the safety pins after the pilot is seated in the cockpit of the aircraft.

3. Check the presence of the pyrocartridge in the catapult seat and the charge for emergency ejection of the belly tank.

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Monitoring for the presence of the ejection firing cartridge is carried out by removing the signal device from the head of the ejection cartridge chamber. The signal devices should not function when pressed.

4. Inspect the cockpit and make sure that all circuit breakers and armament control system switches are closed, and the buttons for ejection, firing and launching are closed with safety caps. [36]

5. While conducting work on loading and unloading the cannon and rocket pods, and suspension and removal of rocket-launching devices, a red flgg is placed 3-5 meters in front of the aircraft, to warn that traffic in this direction is prohibited. At night a red lantern is used for this purpose.

2. Preparation of the Sight Equipment

Preflight preparation of the sight equipment consists of conducting a visual inspection and checking the overall functioning of the sight complex. This check is carried out in preparing any type of armament of the aircraft.

Preparation of the aircraft infrared visor SIV-52 is carried out only when preparing the armament for use at night. (Fig. 10)

To shorten the time of overall preparation, inspection of the operating condition and checking of the overall functioning of the sight are conducted simultaneously while checking the control systems of the armament being prepared for use.

The following is required in preparing the sight equipment:

1. Check the following by visual inspection:

a) Armored glass of the cockpit, the light filter, the reflector and lens. Make sure that they are complete, the fastenings are secure and that they are free of dust, dirt, and grease spots.

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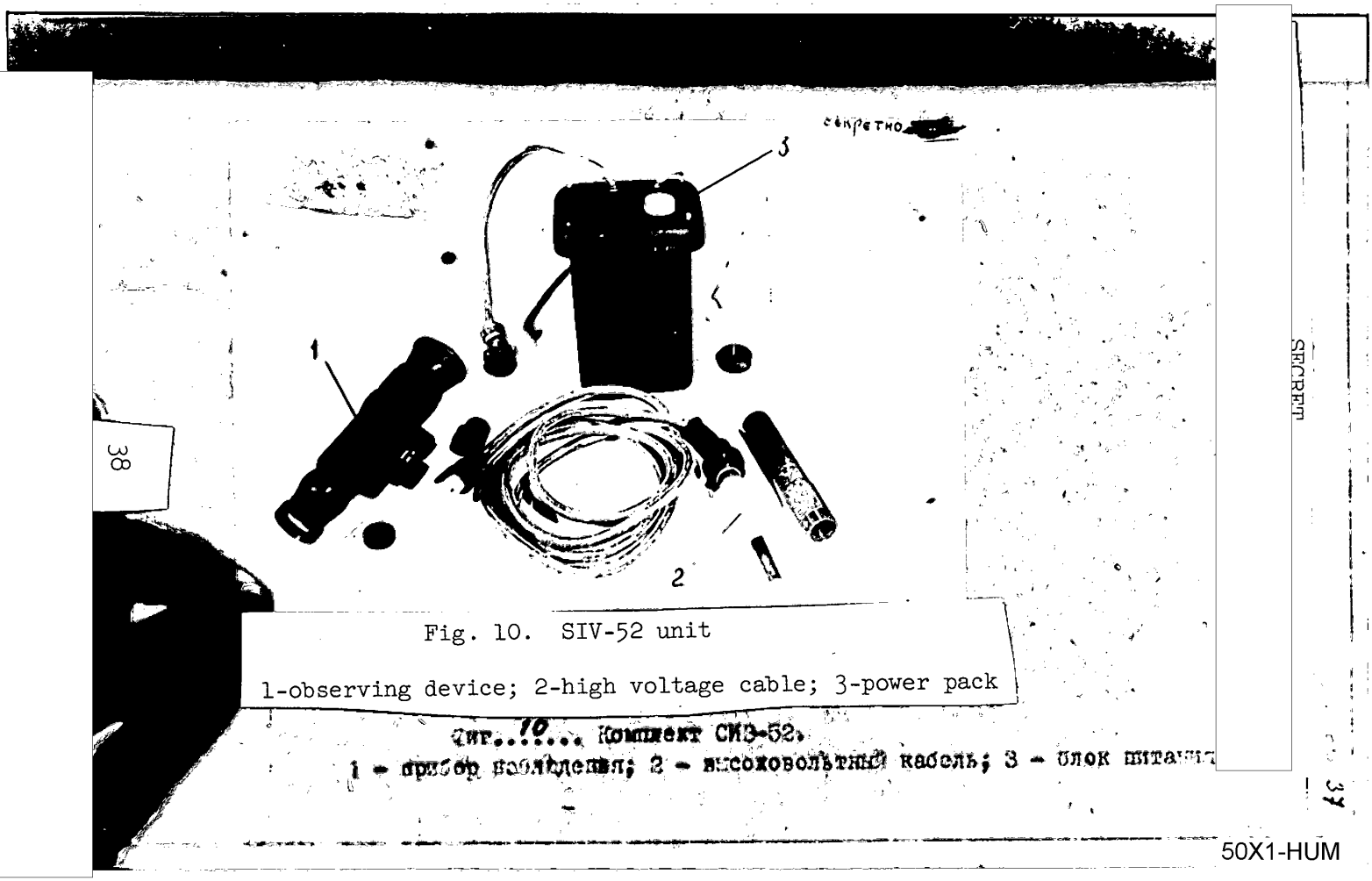

Fig. 10. SIV-52 unit

1-observing device; 2-high voltage cable; 3-power pack

Фиг. 10. Комплект СИЗ-52.

1 - прибор наблюдения; 2 - высоковольтный кабель; 3 - блок питания

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While cleaning the optical system, special care should be observed not [38] to damage the coating on the reflector and lens.

Cleaning of the optical system is authorized only when dirt is present by using a clean flannel napkin. Grease spots should be removed with a napkin soaked in alcohol;

b) Dependability of the light filter stops in the operating and rest positions;

c) The condition of the chromium strip on the lens.

In those places where the chromium strip touches the contacts, there should be no burning (black spots);

d) Smoothness of rotation of the crank handles for the light intensity rheostat, the sighting angles, their bases and the reliability of their stops in operating positions;

e) Check the tightness of the sight head on the bracket. Graduation lines on the bracket, placed there during pre-sighting, should coincide.

2. Remove the protective cover on the DUAS attack and slip angle sensor vanes and check their conditions by visual inspection. Make sure the vanes move freely. When removing the covers, be careful not to damage the vanes of the sensor.

3. Check the condition of the heating circuit for the attack and slip angle sensor.

This work is carried out simultaneously while checking the functioning of the heater for the air pressure sensor, because all of the DUAS-8M heating circuits are included in a single circuit breaker "Oboyrev PVD, Chasy" ("heater PVD, hours"). The circuit breaker is situated below the right hand part of the instrument panel.

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If the heating circuit is working properly, then shortly after [39] emergizing the circuit breaker, the sensor tube near the heating elements heats up. This may be readily determined by feeling with the hand.

WARNING: In the event of slight heating of the circuit breaker tube, the "heater PVD, hours" [circuit breaker] should be disconnected immediately.

4. Make a general inspection of the working order of the sight and the DUAS-8M.

Carry out the inspection with a ground source of current by plugging in the switch marked "Akkum. bortovoy aerodrom" ("battery, ship airfield").

The order of inspection is outlined in the chapter titled "Technical maintenance of the sight equipment".

5. If the aircraft is equipped with an infrared viewfinder SIV-52, it is necessary to check its external condition and general working order.

Inspection is done in the following order:

a) Remove the cover from the lens of the observing instrument;

b) Make an external examination of the observing instrument and the optical alignment element OES-2 in the sight.

When inspecting, check the following:

- the bracket tightness of the various parts of the instrument;

- external surfaces of the optics of the observing instrument and the OES-2;

- the presence of a gap between the hinge on the SIV-52 securing collar and the reflector on the sight. This gap should not be less then 2.5 millimeters;

- completeness of all optical components of the observing instruments;

- the presence of a gap between the lens and the OES-2. The lens should not touch the OES-2;

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c) Plug in the "SIV-52" circuit breaker and make sure that, in the [40] field of vision of the observing instrument, there are no background defects, glowing spots and points, bright lines, scratches or other defects on the working portion of the screen.

WARNING: It is forbidden to plug in the SIV-52 in the bright light with the observing instrument lens open. When checking in the day time, cover the lens with your arm or darken the cockpit.

d) Plug in the circuit breaker "Pritsel, Obgrev Pritselz" ("sight, sight warm-up") and make sure that the brightness of the sight screen in the field of vision of the SIV-52 instrument changes on rotation of the lighting rheostat crank from maximum to total extinction. When this is done, the central point of the instrument should be located approximately in the center of the field of vision of the observing instrument;

e) Unplug the "SIV-52" circuit breaker and "sight, sight warm-up".

Servicing of the range only radar is conducted in accordance with instructions in Book Three.

3. Preparation of the Cannon Armament

In cases when the aircraft is unarmed, preparation of the gunnery system is conducted as follows:

1. Ascertain through the cartridge ejection port that the locking aggregate of the cannon is in the forward position.

2. Open the access hatch to the cannon. (Fig. 11)

3. Open the circulating valve of the hydraulic system of the aircraft, which is located in the right wheel niche, engage the safety catch and lower the speed brakes.

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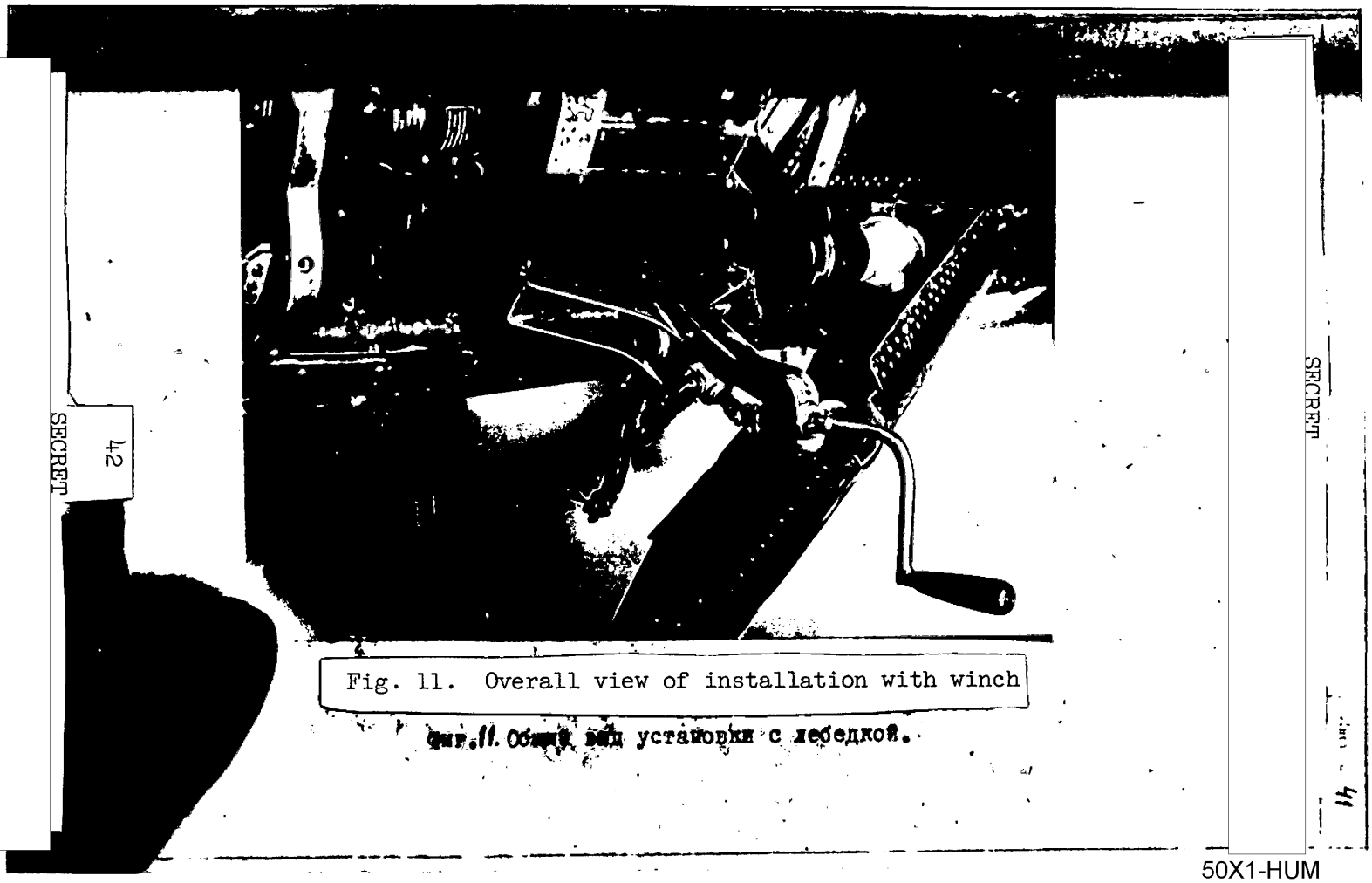

Fig. 11. Overall view of installation with winch

Фиг.11. Общий вид установки с лебедкой.

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The speed brakes are opened manually by pulling them with the hydraulic circulating valve in the open position. [42]

Before opening the circulating valve, it is necessary to reduce the pressure in the hydraulic system of the aircraft to zero, which is done by pumping the control stick of the aircraft.

WARNING: Lowering of the speed brakes for inspecting the gunnery system by pressing the button on the aircraft control stick and switching over to the gas sector is forbidden.

4. Make a visual inspection of the cannon mountings, the gas deflector fastening, gas discharge and pneumatic reloading systems.

5. Check the condition of the electrical conductors, the tie-down and the condition of the locks on the plug connectors for the electric trigger and to the solenoid for the electropneumatic reloader.

6. Check to see whether or not there are any cartridges in the gun receiver and in the feed track.

7. By visual inspection, with the power off, check the condition of all circuit breakers in the gunnery control circuit, the reload buttons, and the fire control.

8. Connect a ground source of electrical energy to the aircraft.

9. Turn on the selector switch having the notation "Akkum. bortovoy aepodrom" ("plane battery airfield") and circuit breaker "NR, SS, RS, FKP".

10. On the sighting bracket, set the "SB" switch in the "S" position, and the "NR-30-RS" switch in the "NR-30" position.

11. Connect the "Pushka" ("cannon") circuit breaker and check the functioning of the control circuits by reloading and operating the movable [43]

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parts of the cannon.

At the same time, ascertain the proper functioning of the gun and the functioning of the signal light indicating combat readiness.

When reloading, hold the reload button in the flush position for two-three seconds.

WARNING: It is categorically forbidden to stand in front of the barrel of the weapon during the reloading.

12. Wipe out the cannon barrel, first placing the movable parts in the rearward position.

WARNING: Wiping out the barrel with a cartridge in the breech extractor and with the locking aggragate in the forward position is forbidden.

13. Disconnect all switches and armament circuit breakers and disconnect the ground electrical power source from the aircraft circuit.

14. Check the condition of the cartridges, noting their quantity and loading in the cartridge belt.

15. When preparing the gun for training firing, examine and prepare the metallic belt and ascertain its length in relation to the quantity of ammunition.

16. Make sure that the latches on the housing of the gun feed mechanism are closed.

17. Load the gun in accordance with the flight mission.

18. Link up the belt with connecters, install the lower link guide and [44] the cover on the feed sleeve. Close the access hatches leading to the gun installation and the speed brakes.

19. Prepare the sight equipment.

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In the event that the basic load is stored on the aircraft and the gun is loaded, preparation for combat flight includes merely wiping the barrel and visual inspection of the cindition of the gun installation.

In the event of an urgent flight, the engineer may decide that wiping the cannon barrel, if it is not dirty, may be omitted.

If the aircraft is engaged in training firing, the above outlined sequence and extent of work should also include gun unloading from which point preparation work should begin.

The sequence for inspecting the gun armament control systems, preparation of ammunition, and different variations of loading, are outlined in the chapter on servicing the gun armament.

WARNING: Gun loading is authorized only after checking the workability of the control systems of the entire armament system.

IV. PREPARATION OF THE HOMING MISSILE SYSTEMS

Preparation for the homing missile systems for combat use may be conducted either at the aircraft's parking strip, or on the field at the preliminary start line.

In preparation, it is necessary to: [45]

1. Make a visual inspection of the suspension aggregate. During the inspection, pay special attention to:

(a) The closing of the suspension lever locks DZ-57;

(b) Cleanliness and working order of the launch control mechanism;

(c) Cleanliness of the ignition contacts. Check the spring properties of the contacts and the absence of grease on them;

(d) The condition of the connection of the plug socket of the wing pylon

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to the mate plug APU-13. With proper connection, the space between the plug collar and the socket face should not be less than 2.5 millimeters;

(e) The functioning of the stop catch for locking the forward homing missile guide on the launch mechanism;

(f) Operation of the vibration dampers;

(g) Condition of the fastenings on the forward fairing of the launch mechanism;

(h) Condition of the springs on the forward ejection bracket and catches, which serve to secure this bracket to the missile release connection.

2. Inspect the over-all functioning of the sight equipment.

3. Check the functioning of the power circuits, launching, and control with the aid of an II-13A unit.

4. Switch off the battery and install a safety pin in the launch mechanism.

5. Make a visual inspection of the missile, check its readiness according to the instruction sheet and suspend the missile from the launch mechanism. (Fig. 12)

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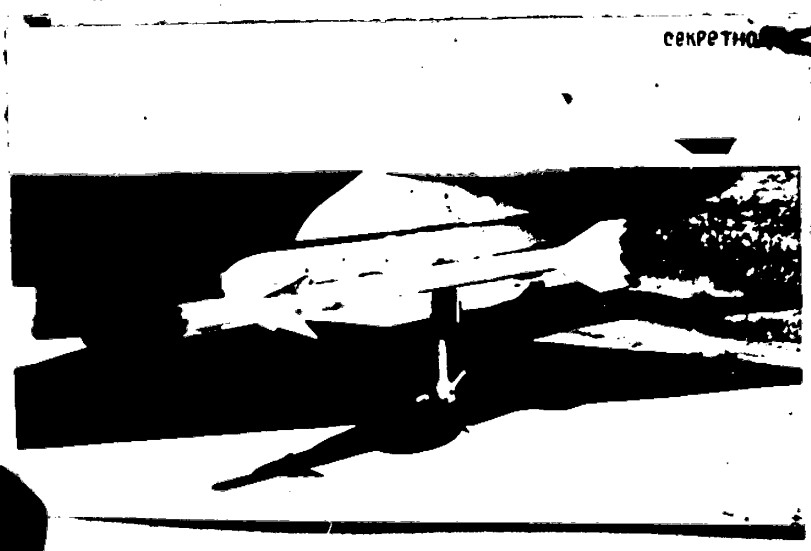

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Fig. 12. Overall view of suspended missile (dummy)

Фиг. 12. Общий вид подвешенной ракеты (макет).

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6. Check the fastening of the rocket to the missile launch mechanism [47] according to the graduations through capped ports in the side walls of the beam.

The graduation marks on the double arm lever of the stop catch mechanism should not extend beyond the graduations inscribed on the projections on the forward vibration damper plates in the direction of lesser overlap.

7. Check the head of the suspended missile for emission of audible signal to the pilot's headset, for which it is necessary to:

(a) Check for the presence of a safety pin in the launch mechanism and connect the airfield power supply to the aircraft;

(b) Remove the protective cover from the head;

(c) Switch on the ground power supply, turn on the battery in the cockpit and the circuit breakers "Obogr. SS" ("warm-up SS"), "Nakal SS" (filement heat SS"), and "Ratsia manom. masla" ("oil pressure gauge transmitter"). Make sure that after turning on the "filement heat SS" circuit breaker, the signal lights "Podveshen SS" ("suspended SS") and "Lev.-Prav." ("left-right") located in the upper right portion of the instrument panel are burning.

WARNING: Plugging in the power supply to the rocket, before removing the protective cover from the head, is forbidden;

(d) Set the launch selector switch on "Odinochno" ("single"), and the launch distribution switch on "launch SS" "Left-right" in the position, corresponding to the launch mechanism being checked;

(e) At a distance of 10-15 millimeters from the aircraft, irradiate it with the aid of a pocket flashlight, focusing with a narrow beam of light.

When the head is irridated, an audio signal should be heard in the pilot's headset. The intensity of the sound signal is regulated with the volume control;

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(j) Make an similar check of the functioning of the missile head [48] suspended on the other frame.

8. Before flight, remove the protective cap from the head, the protective covering from the optical detonator compartment, the rubber caps on the missile rudders for protecting the contact detonator sensors, and the safety pin from the launch mechanism.

The area, selected for suspending the rockets, should allow the aircraft to be pointed in a direction unobstructed by buildings, facilities, or other objects.

Work on missile suspension is permitted to begin only after completion of engine testing and after preflight preparations on the remaining systems of the aircraft are completed. The use of open flames, smoking, and the use of non-standard and impact tools are not permitted.

All electrical repair work on the aircraft, when missiles are suspended, is categorically forbidden. When towing the aircraft with missiles suspended it is necessary to place a safety pin in the APU-13 and check the position of the switch and circuit breaker in the aircraft cockpit. All switches and circuit breakers should be in the "off" position.

Connecting the ground power supply to the aircraft when the missiles are suspended should be done only after being satisfied that the circuit breakers in the rocket launch control circuit in the cockpit are switched off and there are no people standing in front of or behind the aircraft. Doing any kind of work in the cockpit when the missiles are suspended after plugging in the ground power supply to the aircraft is FORBIDDEN.

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5. PREPARATION OF THE ROCKET ARMAMENT [49]

Preparation of the rocket armament for combat use is conducted in the following order:

1. Make a visual inspection of the suspension aggregates. During the inspection, check the following:

(a) The absence of dirt on the suspension aggregates, closing of the maintenance hatches and the locking levers on the wing pylons;

(b) Correct tightening of the rocket pod lugs with the aid of a torsion wrench;

(c) The contact of the plug connector on the wing pylon to the socket on the suspended pod.

2. Remove the rear fairing of the pod, connect the electrical power source, and with the aid of a tester, check the voltage output on the pod contact socket for the prongs of the rocket cords.

3. Set the PUS-36D in the zero position, the fire selector switch in accordance with the mission, and disconnect the electrical power source.

4. Examine the rockets and detonators prepared for loading into the rocket pods.

5. Load the pod, observing established safety rules.

6. Confirm the fastening of the rear fairing of the rocket pod.

Preflight work is conducted in accordance with the requirements outlined in the chapter on the technical servicing of the rocket armament.

6. PREPARATION OF THE GUN CAMERA SSh-45-I-100-OS [50]

In preparing the gun camera for use:

1. Make a visual examination of the fastening and the optical details.

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When necessary, clean the lens.

2. Check the functioning of the control circuit and at the same time check the armament control circuit in conjunction with which the gun camera is used in flight.

3. When necessary, check the alignment - the accuracy with which the optical axis of the gun camera coincides with the central point of the sight.

4. Install the correct diaphragm and light filter required for the proposed exposure conditions.

5. In the event of photographing with the use of the timing mechanism, set the VM-2 switch in the "VKL" ["on"] position, and place the pointer on the time setting required by the mission. (Fig. 13)

6. Obtain and examine the cassette which was loaded in the photographic laboratory.

7. Open the gun camera lid and install the loaded cassette. Before installing the cassette, make the required notation on usage on the film with a soft pencil through the exposure aperture.

8. Carefully close the instrument cover and check the functioning of the gun camera and film winding by running it briefly.

Preparation of the gun camera is carried out before loading the gun and rocket armament.

The work sequence in preparing the gun camera is outlined in the chapter "Technical Servicing Equipment For Photomonitoring of Aerial Fire."

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Fig. 13. Overall view of timing mechanism VM-2

Фиг. 13. Общий вид временного механизма ВМ-2.

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CHAPTER III

[52]

PREPARATION OF THE ARMAMENT FOR REPEATED FLIGHT

1. General Remarks

The time alloted for preparation for repeated flight must be sufficient for arming the aircraft and preparing it in accordance with the requirements for scheduled flight.

Preparation of the aircraft's armament for repeated flight may be conducted either on flight line or on the parking strip, and includes the following:

1. Postflight inspection to the extent required for fulfilling scheduled missions.

2. Inspection of functioning of the armament and correction of defects detected in flight and during postflight inspection.

3. Loading of ammunition, in accordance with the mission.

Before starting the inspection, obtain the pilot's comments on the operation of the armament in flight, and when necessary reload the gun and RS pods, and remove the missiles from the launch mechanism.

Postflight inspection is carried out only on that armament which is likely to be used in the next flight, and to that extent which would fully guarantee functioning of that armament.

Preparation and inspection of ammunition, designated for the next [53] mission, should be carried out before the aircraft lands.

2. In preparing the gun armament it is necessary to:

a) Open the access hatch and prepare the gun for subsequent loading;

b) Remove the empty cartridge case or live cartridge from the breech

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extractor and remove any remaining cartridges and spent links from the feed track according to methods specified in the chapter on servicing the gun armament.

To save time, the winch cable may be withdrawn at the same time that the spent links are removed;

c) Inspect the mounting on the gas defector, the guide sleeve, connections in the pneumatic system, and the electrical connections;

d) Test the reloading system, fire control, and combat readiness indicators from the cockpit of the aircraft;

e) Arm the cannon with a new load and close the gun compartment hatches.

Removing the gun for cleaning purposes should only be done if there were a large number of firings, as outlined in the instructions on gun maintenance. On the other hand, gun cleaning may be accomplished without removing it from its mountings.

3. In preparing the homing missile system it is necessary to: [54]

a) Make a visual inspection of the suspension aggregates. When inspecting, pay special attention to:

- The condition of the fastening of the launching mechanism to the wing pylon;

- The condition of the guides, catches and vibration dampers of the launch mechanism;

- Cleanliness of the ignition contact points and the condition of the electrical contact between the pylon and the launch mechanism;

b) Open the forward fairing of the launch mechanism and disconnect the launch connector of the spent missile from the ShR-M20 connector;

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c) Check the overall functioning of the sight equipment;

d) Inspect the functioning of the feed, launch, and control circuits with an II-13 A tester.

WARNING: If an unexpended missile is present on one of the suspensions, checking the functioning of the control circuit is authorized only after removing it from the launch mechanism;

e) Suspend the missiles and make sure they are locked on the launch mechanism;

f) Ascertain the condition of the head of the suspended rocket by checking the emission of the audio signal in the pilot's headset;

g) Before takeoff, remove the protective cap from the head, the protective cover from the optical detonator compartment, the rubber caps placed on the rocket rudders for protecting the contact detonation sensors, and the safety pin from the launch mechanism. [55]

4. In preparing the unguided rocket armament it is necessary to:

a) Inspect the wing pylon and check the condition of the fastening on the rocket pod;

b) Remove the rear fairing of the pod;

c) Remove, from the contact sockets, the prongs of the charge wires and remove the rocket retainers from the pod barrels. Remove, from the pylon socket, the rocket plugs with the charging wires and ascertain the correctness of their parts;

d) Examine the rocket armament control aggregates in the cockpit of the aircraft;

e) Check the condition of the fire control circuit and set the PUS-36 D in the zero position;

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f) Disconnect the electric power and load the rocket pod;

zh) Make sure that the rear fairing of the pod is closed.

5. The sight equipment is prepared independently of the type of armament used.

Preparation of the sight and the infrared viewfinder SIV-52 for repeated flight consists of conducting a visual inspection and checking the overall functioning. This includes:

a) Check for the absence of dirt on the armored glass of the cockpit, [56] the reflector, and the lens. If necessary, clean them;

b) Check the condition of the sight head fastening to the bracket;

c) Check the smoothness of rotation of the sight control cranks;

d) Switch on the sight and check its functioning in respect to change in size of the reticule and its movement while turning the crank of the potentiometer for manual range control;

e) Check the functioning of the sight and the range only radar;

f) Check the condition and operation of the infrared viewfinder.

After completing the inspection, the circuit breaker marked "Pritsel, Obogrev pritsela" ("sight, sight warm-up") is left in the on position.

6. In preparing the photomonitoring equipment it is necessary to:

a) Make a visual inspection of the gun camera and check the conditions of its fastening;

b) Check the correctness of control. This is done after unloading the gun camera at the same time that the armament control circuits are being checked;

v) Insert a loaded magazine into the gun camera. Make a notation on the film through the exposure aperature of the cassette regarding its use;

g) Set the required time on the VM-2.

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PART TWO

TECHNICAL SERVICING OF SYSTEMS AND INDIVIDUAL AGGREGATES OF THE AIRCRAFT ARMAMENT

[57]

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CHAPTER I [58]

TECHNICAL SERVICING OF THE ASP-5P-5ND SIGHT WITH THE DUAS-8M ATTACK AND SLIP ANGLE SENSOR

1. General Remarks On The ASP-5ND Sight

The ASP-5ND gun sight together with the attack and slip angle sensor DUAS-8M is intended for sighting when firing from the gun, the unguided rockets, and when launching the homing missiles.

The gun sight solves angular corrections for the following conditions:

- Target Range	from 200 to 2,000 meters
- Altitude	from 500 to 25,000 meters
- Target velocity	from 500 to 2,250 kilometers per hour
- Actual velocity	from 500 to 2,500 kilometers per hour
- Ambient air temperature	from -60°C to + 50°C

The accuracy of angular corrections is maintained when using direct current 27 plus or minus 10 percent volts and alternating current 115 plus or minus 5 percent volts with a frequency of 400 plus or minus 5 percent cycles.

Input under normal conditions is 300 watts.

- With direct current at T = -40°C and lower, 400 watts.
- With alternating current, 120 watts.

The total angular corrections for lead and sight are determined in [59] relation to calculated time, which is computed as a function of range and altitude.

Range may be introduced to the gun sight from the SRD-5MIE range only radar, which is connected electrically to the gun sight, or from an externally mounted optical range finder with the aid of a crank near the throtle.

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With the range only radar switched on, but without target lock on, the gun sight automatically switches over to operation from the optical range finder; with target lock on, it shifts back to the range only radar.

Should the range only radar not function, or in the event of strafing or aerial fire at low altitudes, there is a provision on the gun sight for manual switching over to optical externally mounted range finder.

Unlike similar gun sights, the ASP-5MD sight has higher accuracy of fire for the unguided rockets because of lag angle allowance.

Estimation of the lag angle for the unguided rockets is done from the attack and slip angle sensor DUAS-8M which is electrically connected to the sight, or from the altimeter lead, as a function of Height H, average velocity at that height Vcp H, and the average overload value at that height θH.

For operation under night conditions, the sight is optically connected with the aircraft infrared viewfinder SIV-52. (Fig. 14) [60]

In the K-13 system, the sight is used like an ordinary collimator viewfinder, in which the arresting lever of the gyroscope must be set in the "stationary" position.

The arresting lever on the sight head gyroscope must be in this position during steering, takeoff, and landing of the aircraft.

To disconnect the sight, it is first necessary to arrest the gyroscope head, moving the arresting lever from the position "Giro" ("gyro") to "Nepod" ("stationary"), and only then disconnect the power supply circuit breaker.

When working with the sight, all switches for operating conditions, located on the sight head bracket, should be set in positions corresponding to the character of the missions

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(a) The "NR-30-RS" switch for firing from the gun and for launching the K-13 missiles, should be set in the "NR-30" position.

The switch is set in the "RS" position only for firing the unguided rockets.

(b) The switch for changing over the operation of the sight from the altimeter mechanism or from the attack and slip angle sensor "N-DUAS" should be set in the "DUAS" position when firing the unguided projectiles, and only in position "N" in cases where the "DUAS-8M" is faulty.

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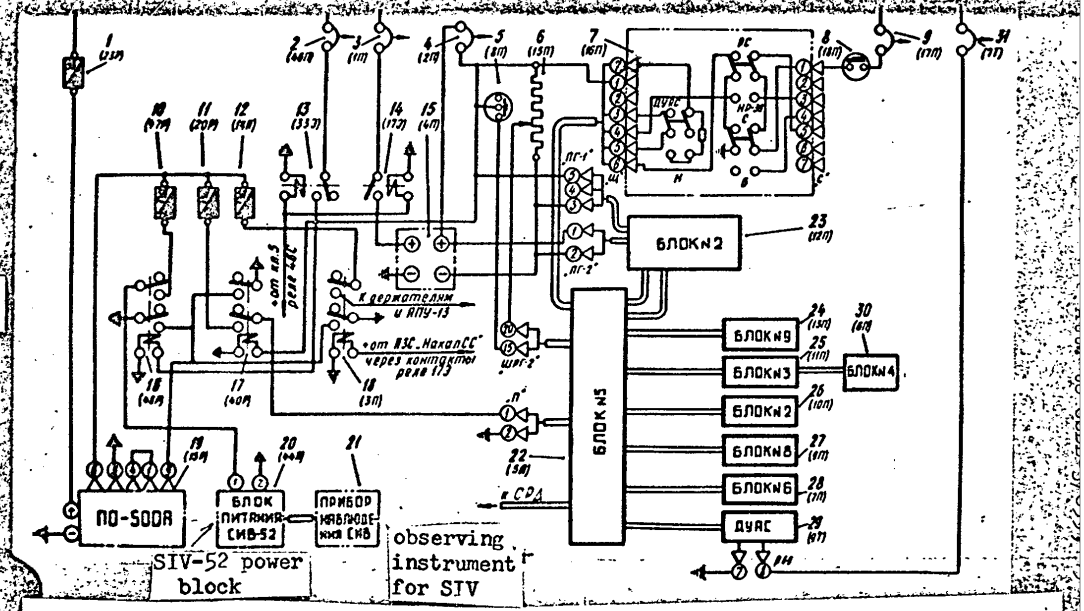

Fig. 14. Main wiring diagram for ASP-5ND, SIV-52, and DUAS-8M

Рис. 14. Принципиальная электросхема управления АСП-5НД, СИВ-52 и ДУАС-8М.

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Fig. 14 Main wiring diagram of ASP-5ND, SIV-52 and DUAS-8M [62]

1 - Inertial safety catch IP-50 for the PO-500A transformer circuit;

2 - AZS-5 [circuit breaker-5] for power supply to SIV-52 viewfinder;

3 - AZS-20 [circuit breaker-20] for switching on sight heating circuits;

4 - AZS-10 [Circuit breaker-10] for switching on sight circuits;

5 - Sight damping button;

6 - Potentiometer for manual control of range;

7 - Panel with sight switches;

8 - Firing button;

9 - Main circuit breaker for armament control circuit switches;

10 - Safety switch SP-5;

11 - Safety switch SP-5;

12 - Safety switch SP-5;

13 - Heavy duty relay (block type);

14 - Heavy duty relay (block type);

15 - Filter F-14 A for radio static;

16 - Relay TKE-52 PD, for power supply switch to SIV-52;

17 - Relay TKE-52 PD for switching on direct current power supply to sight;

18 - Relay TKE-52 PD for switching on alternating current to missiles;

19 - Transformer PO-500 A;

20 - Power pack for SIV-52;

21 - Observing instrument SIV-52;

22 - Sight control box;

23 - Sight head ASP-5ND;

24 - Voltage regulator for ASP-5ND;

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25 - Null-type gyroscope for ASP-5NB;

26 - Computer for ASP-5 ND;

27 - Electronic relay for ASP-5 ND;

28 - Altimeter mechanism for ASP-5 ND;

29 - Attack and slip angle sensor DUAS-8M;

30 - Amplifier for null-type gyroscope ASP-5MD;

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31 - AZS-20 circuit breaker -20 for DUAS-8M heating and time.

The position of this switch has no significance for firing the gun or [P 63] launching the K-13 missiles.

c) The third switch "S-B", located on the left side of the sight bracket, must be set in position "S" for firing the gun, the unguided rocket pods, or for launching the missiles.

d) A signal light "RD-vysokoye Nyapr" ("RD-high voltage"), showing the presence of high voltage in the sight when switching on the range only radar and the sight operating switch "Radio-Opt" (Radio-Optic"), is located on the right side of the sight head bracket wall.

The sight has a light indicating target lock on by the range only radar and a signal light showing pull-out from attack after firing the gun or rocket pods.

The red signal light "Vykhod" ("pull-out") lights up at a distance of 600 plus 50 or minus 20 meters from the target.

A visual range control from 200 to 2000 meters to the target for the gun and unguided rocket system is conducted from a firing indicator located on the sight head bracket.

2. Location of Sight Units on the Aircraft [P 64]

1. The sight head is installed along the axis of symmetry over the instrument board.

The head is situated so that the central beam in the view finder is inclined downwardly at an angle of 1°30' in respect to the structural horizontal of the fuselage.

The distance between the optical axis of the sight head collimator from a plane passing through the center of the forward mount of the gun perpendicular

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to the longitudinal axis of the aircraft, is equal to 1,550 millimeters; the distance of the reflection point of the central beam of the collimator on the reflector of the sight head from the structural horizon of the fuselage is equal to 816 millimeters.

As a result of the refraction of the front windshield, the central beam of the view finder passes through the windshield at a point located higher than the structural horizon of the fuselage by 844 millimeters.

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-- For the vertical axis -- plus or minus 45" [P 65]

-- For the lateral axis -- plus or minus 30'

-- For the longitudinal axis -- plus or minus 30'

3. The electronic amplifier for the null-type gyroscope is installed in the forward equipment hatch between frames No 5 and 6 to the right and above.

4. The control box is installed in the forward equipment hatch between frames No 5 and 6 to the left and above.

5. The altitude mechanism is installed in the forward equipment hatch between frames No 5 and 6 in the center and above (between the gyroscope amplifier and the fire control box).

6. The electronic relay is situated in the forward equipment hatch between framed No 5 and 6 to the right and above (together with the gyroscope amplifier).

7. The voltage regulator is installed in the cockpit behind the instrument panel on the aircraft's plane of symmetry between frames 6 and 7, above the structural horizon.

8. The radio static filter is installed in the aircraft's cockpit to the right, behind the seat near frame No 11 together with the power pack for the SIV-52.

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3. GENERAL REMARKS ON DUAS-8M [P 66]

The DUAS-8M sensor is a tube in which are mounted the PVD-5 air pressure receiver to operate the diaphragm-type aneroid instruments and the sensors of the angles of attack and slip (fig 15).

The DUAS-8M sensor is mounted on the forward end of the PVD rod. The electric wire of the sensor is run inside the rod and is connected to the electrical system of the sight by a nine-terminal plug. The plug is serviced through the hatch to the ARK frame antenna in the lower nose portion of the fuselage.

The sensor has four vanes, fastened in pairs on two mutually-perpendicular axes, for measuring the angles of attack and the slip. The forward pair of vanes measures the slip angle, and the rear pair, the angle of attack of the airplane.

The operating principle of the sensor is based on a change in the relative resistance output (voltage) in respect to the position of the vanes. For each given position of the vane there is a corresponding definite value of the relative resistance output (voltage), represented by the ratio $\frac{R\ output}{R\ total}$ in %.

With a change in the aircraft angle of attack or slip, the vanes of the sensor tilt to a certain angle, so that the brushes attached to the counterweights of each pair af vanes slide along stationary potentiometers, thus changing the magnitude of the output voltage. This voltage, picked up by the potentiometers of the attack and slip angle sensors, passes into P_{18} potentiometer of the sight head, which is the receiving section of the tracking system for computing the current lag angles RS. [P 68

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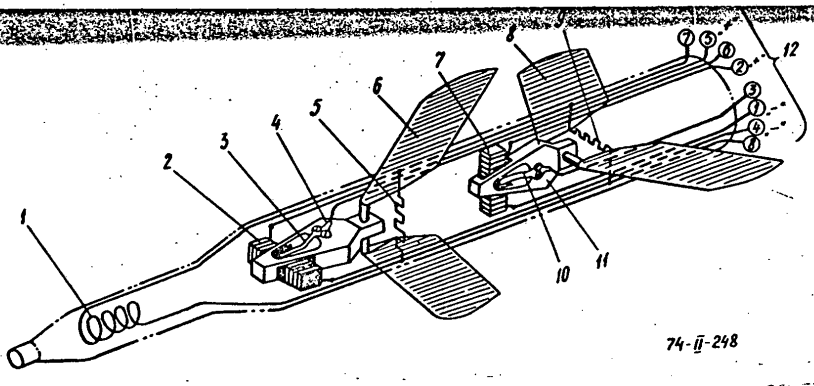

Fig. 15. Electromechanical diagram of DUAS-8M sensor

Фиг. 15. Электромеханическая схема датчика ПУАС-8М.

1-обогрев ПВД; 2-потенциометр угла скольжения; 3-ползунок потенциометра; 4- противовес; 5-обогрев датчика угла скольжения; 6-флюгер датчика угла скольжения; 7-потенциометр угла атаки; 8-флюгер датчика угла атаки; 9-обогрев угла атаки; 3-обогрев датчика угла атаки; 10-ползунок потенциометра; 11-противовес; 12- электроразъем.

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Fig. 15. Electromechanical diagram of the DUAS-8M sensor [P 67

1 - Heating element of the PVD

2 - Potentiometer for the slip angle

3 - Sliding contact for the potentiometers

4 - Counter weight

5 - Heating element for the slip angle sensor

6 - Vane for the slip angle sensor

7 - Potentiometer for the angle of attack

8 - Vane for the angle of attack sensor

9 - Heating element for the angle of attack

9 - Heating element for the angle of attack sensor

10 - Sliding contact for the potentiometer

11 - Counter weight

12 - Electric plug

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To protect the vane and PVD mechanisms from iceing up, heating elements are installed inside the tube. The heating elements are switched on simultaneously with the PVD-5 heating element by the circuit breaker "Obogrev PVD, chacy" ("Heating element of the PVD, clock") located in the cockpit of the airplane on the instrument panel.

Power consumption with 27 volts ± 10% is:

a) For the heating elements of the vane mechanisms - from 2 to 3 amperes;

b) Together with the heating element of the air pressure receiver -- from 7 to 10 amperes.

In testing the power supply of the angle of attack and slip sensor potentiometer , no more than 22 volts of direct current should be applied to the slip angle potentiometer or 30 volts to the angle of attack potentiometer. On the airplane, the potentiometers of the sensors are fed by a stabilized current 22 volts through the sight.

The rod with the DUAS-8M is mounted on the airplane in the plane of symmetry, relative to structural horizontal in the same way as other armament aggregates, at an anble of 1°30'.

Maximum vane angles are: [P 69]

a) For the potentiometer of the slip angle, +5°18'

b) For the potentiometer of the angle of attack, -5°54' (down) and +17°42' (up).

NOTE: The above maximum vane angles correspond in flight to slip angles of angles of ±4°30' and angles of attack of from -5° to +15°.

The relative voltage between the potentiometer arm and its negative end changes linearly with the deflection angle of the vanes.

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The relative voltage output increases as the slip angel vane pivots to the left or the angle of attack vane pivots up looking from above and along direction of flight.

For the slip angle:

Slip angle	Deflection Angle of the vane	Nominal magnitude of the relative voltage in %
-4°30'	-5°18'	0
-2°15'	-2°39'	25
0	0	50
+2°15'	+2°39'	75
+4°30'	+5°18'	100

For the angle of attack: [P. 70]

Angle of attack	Deflection Angle of the vane	Nominal magnitude of the relative voltage in %
-5°	-5°54'	0
-3°	-3°32'	10
0	0	25
+3°	+3°32'	40
+6°	+7°05'	55
+10°	+11°48'	75
+15°	+17°42'	100

Errors in the relative voltage should not exceed:

a) for the angle of attack, ± 2%

b) for the slip angle, ± 3%

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4. CHECKING THE GENERAL READINESS OF THE SIGHT WITH THE DUAS-8M [P 71]

The total efficiency is checked during preparation of the sight equipment for use.

During the preliminary preparation of the armament it is necessary to:

1. Check the operation of the sight from the optical range-finder, by:

a) Opening the front equipment hatch;

b) Making sure that the switch on the control box is set at position "21";

c) Switching on the "Akkum, bortovoy, aerodrome" ("Aircraft battery, airfield") switch and the circuit breaker, "Pritsel, obogrev pritsela" ("Sight, heating element of the sight") and "Pritsel" ("Sight") on the right panel;

d) Setting the switches "V-S," "NR-30-RS," and "N-DUAS" on the sight head bracket to positions "S," "NR-30," and "N" respectively;

e) Set the "Radio-Optica" ("Radio-Optics") switch on the sight control panel to the "Optics" position, and after 1.6-2 min (the warm-up time) begin to check the total efficiency;

f) Set the arresting handle in the "Gyro" position;

g) Make sure that the range lever of the engine control lever moves easily and smoothly from minimum range to maximum, during which:

- the "T" and "D" dials of the computer should move; [P 72]

- the arrow on the range indicator should deflect from minimum range to maximum;

- the range circle of the sight graticule should decrease when the range increases and increase when the range decreases;

Conduct the check with a fixed base at 40-45 meters;

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- the sight graticule, with the introduction of maximum range, should tilt down, building up the sighting angle;

- when a range of 600^{+50}_{-20} meters is achieved the red "Vykhod" ("Pull-out") light should burn and burn steadily during subsequent decrease in range.

h) Make sure that:

- with the rotation of the light rheostat crank the brightness of the sight graticule changes from the maximum to complete extinction;

- the range circle increases with the rotation of the crank of the base in the direction of increase and, on the other hand, decreases during a decrease of the base;

- the sight graticule moves down with the rotation of the crank of the reflection angle from zero to maximum, and returns to the initial position on release of the lever;

- at a fixed range, when the lever of the switch is adjusted from the position "NR-30" to position "RS" the sight graticule shifts down, accumulating a component correction from the slip in the plane of symmetry of the airplane;

- when the damping button, located on the control stick of the airplane [P 73] is pressed, the sight graticule goes up, and when the button is released, it returns to the initial position. Conduct the check at maximum range.

2. Check the operation of the sight from "DUAS"

When doing this it is necessary to place the "N-DUAS" switch in the "DUAS" position, and make sure that:

a) With a variation in the position of the vane of the angle of attack sensor relative to the horizontal axis of the rod, the sight graticule deflect along the vertical.

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When the vane of the angle of attack sensor deflects upward, the central point of the sight graticule deflects downward, and when the vane deflects downward, the central point of the sight graticule deflects upward;

b) With a variation in the position of the vane of the slip angle sensor relative to the vertical axis of the rod, the central point of the sight graticule moves in a horizontal direction. When the vane of the slip angle sensor deflects to the left, the central point of the sight graticule deflects to the right, and when the vane deflects to the right, the central point of the sight graticule deflects to the left.

3. Check the operation of the sight from the range-only radar with respect to the gun and unguided rocket systems. The check is conducted in [P 74] the following order:

a) take off the cover of the air-intake;

b) switch on circuit breaker "SRD";

WARNING: Do not switch on the range-only radar until the sight is switched on and the cover of the air-intake is taken off;

c) set the "Radio-Optics" selector switch on the sight control panel in the "Optics" position;

d) make sure that after 2-3 min (the warm-up time of the range-only radar) after it is switched on, if there are terrestrial objects in the zone of the range-only radar's beam, the radar has locked on tb the target, and that the green light "Zakhvat" ("Lock on") continues to burn;

e) by pressing the "Sbrostseli" ("Target release") button located on the mount of the sight bracket on the left, check the working order of the circuit for releasing the target locked on by the range-only radar.

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When the "Release" button is pressed the "Lock on" light should go out, and when it is released, light up again. For checking purposes, it is necessary to press the "Release" button two or three times.

When the range-only radar locks on to the target, a sharp kick may occur in the range circle in the sight with simultaneous change in the reading of the dials on the computer bloc.

4. Switch off the range-only radar and the sight in the reverse order of switching them on.

WARNING: To avoid damage to the flat springs of the terminal switches of the blocs "D" and "T" of the computer and potentiometer P_{15}, at the conclusion of the check on the sight: [P 75]

- the computer range dial at a reading of 400-1600 meters;
- the range circle at 2-7°.

At this time the range dial may be at any position from 17 to 60 meters.

Check the total efficiency of the sight equipment during pre-flight preparation in the same way, with the exception of opening the cover of the equipment.

5. CHECK OF THE TOTAL ANGLES OF LAG AND SIGHT

The check of the total angles of lag and sight for RS is conducted from both the altimeter mechanism and the DUAS.

In both cases the total lag angles are measured with the aid of the KP5S-2 telescope.

1. In checking from the altimeter mechanism:

a) Set up the KP5S-2 telescope and fasten it to the sight head with screws;

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b) Switch on the circuit breaker "Obogrev pritsela, pritsel" ("Heating element of the sight, sight") and "Pritsel" ("Sight"); [P 76]

c) Set the sight head arresting lever on "Gyro," and the selector switches "NR-30-RS" to NR-30" and "V-S" to "S";

d) Set the time to T=1 sec on the computer dial with the manual range input lever;

e) Line up the center of the cross-hairs of the KP5S-2 telescope with the central point of the sight graticule, using the adjustment screws located on the telescope;

f) Set the selector switch "NR-30-RS" at position "RS";

g) Set the time to T=3 sec on the computer dial with the manual range input lever;

h) Looking into the KP5S-2 telescope, make sure that for the S-5M rockets, when the selector switch "N-DUAS" is at position "N" or position "DUAS" (when the vanes are at a null position), a total lag angle of 1°01' builds up in the sight.

When checking the lag angles from the altimeter mechanism, the value of the altitude is given with the aid of the KPU device when the selector switch "N-DUAS" is at position "N".

The value of the total lag angles and sighting at T=3 seconds must correspond to the data in the following table: [P 77]

N v m (Altitude in meters) / Ballistics	2000	20000
S-5M	3°14'	5°04'
Tolerance	±15'	±15'

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In order to secure an altitude of 20000 meters the KPU instrument is attached directly to altimeter block of the sight (block No 6).

Warning: Do not switch off the sight before eliminating negative pressure.

2. In checking the angles of the lag from the DUAS, the values of the angles of attack and slip are arrived at with the help of a device for the determination of the value of the angles of deflection of the corresponding vanes with the "N=DUAS" switch set at "DUAS."

The value of the total angles of lag and sight at T=3 seconds in relation to the angles of attack must correspond to the data in the following table:

[P 78]

Angle of the attack / Ballistics	0°	2°	6°
S-5M	1°13'	2°43'	5°43'
Tolerance	±15'	±30'	±30'

The value of the horizontal components of the lag angles at T=1.5 seconds in relation to the angles of the slip must correspond to the data in the following table:

Angle of the slip / Ballistics	±1°	±2°	±3°
S-5M	0°34'	1°10'	1°58'
Tolerance	±0°20'	±0°50'	±0°30'

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It should be borne in mind that when checking the total lag and sighting angles with deflection in one of the pairs of vanes, the other pair of vanes on the sensor must be in a zero position in relation to the rod axis.

From the tables provided in the section on general information about the DUAS-8M, it is evident that the absolute values of the angles of attack and slip do not coincide with the angles of deflection of the corresponding vanes of the sensor.

In this connection, when the total angles of lag and sighting are measured, [P 79] the vane should be deflected from its zero position in relation to the rod axis as follows:

a) for attack angles equal to 2° --- by 2°22';

b) for attack angles equal to 6° --- by 7°05";

c) for slip angles equal to 1° --- by 1°11';

d) for slip angles equal to 2° --- by 2°22';

e) for slip angles equal to 3° --- by 3°32'.

Checking should be carried out with the help of a device in accordance with the following method.

Checking the Total Angles of Lag and Sight RS

With Variations in the Angles of Attack

1. Place the device (Fig. 16) with the prism on the surface of the housing of DUAS-8M in such a manner that its support is contiguous to the rotation axis of the upper vane of the sensor of the slip angles. Preliminarily fasten the device with the help of a hinge and a wing nut on the lower part of the prism.

2. Set the adjustable rotary planes for the vanes of the attack and slip angle sensors in the zero position by means of the locks and fasten them with a wing nut.

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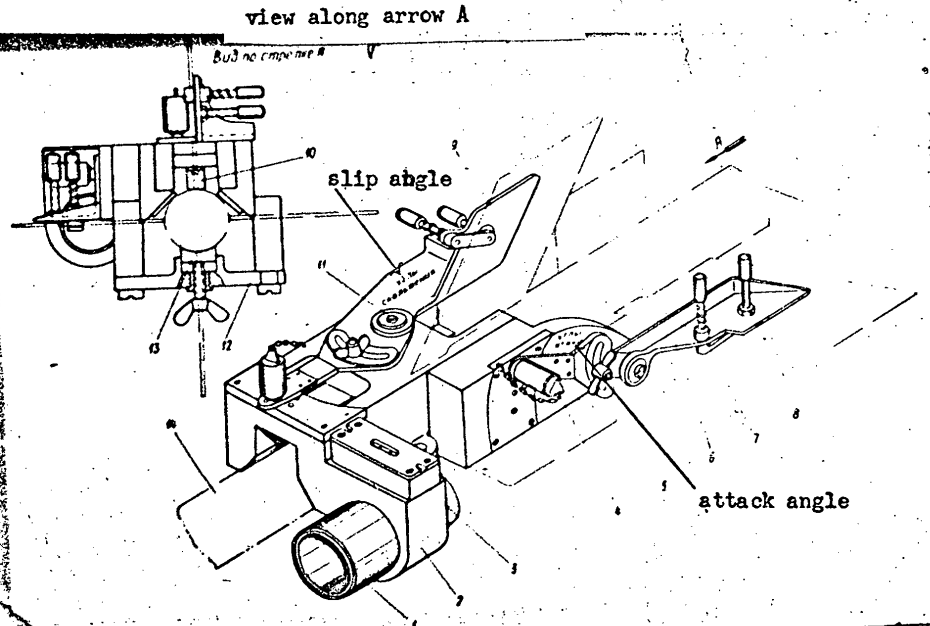

Fig. 16. Device for checking the lag angles built-up by the sight from the sensor DUAS-8M

Фиг. 16. Приспособление для проверки углов отставания, отсчитываемых прицелом от датчика ДУАС-8М. see-pa

built-up by the sight fro[illegible] DUAS-[illegible] (see p. 80)

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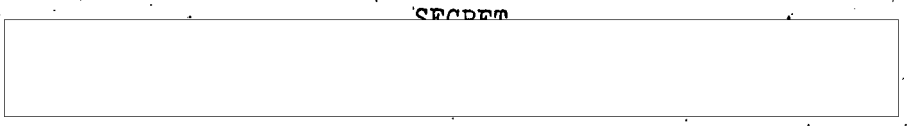

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Figure 16. Device for checking the lag angles, built-up by the sight from the sensor DUAS-8M

[P 81]

1. Bushing for the gun harmonization apparatus
2. Housing
3. Level
4. Lock
5. Wing nut
6. Adjustable plane for the vane of the attack angle
7. Clamp
8. Adjusting screw
9. Adjustable plane for the slip angle vane
10. Brace
11. Axis of rotation
12. Removable plate
13. Clamp
14. Sensor of the Attack and slip angles (DUAS-8M)

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3. By slightly rotating the entire device around the longitudinal axis of DUAS-8M housing, place the device in such a position in which both pairs [P 82] of the vanes will touch the adjustable planes; the device is then fastened firmly on the DUAS-8M housing by means of a hinge and a wing nut. Fasten the vanes of DUAS-8M to the adjustable planes with clamps.

4. Place the optical telescope KP5S-2 on the head of the sighting device and fasten it with screws.

5. Switch on the "Sight warm-up, sight" and "Sight" circuit breakers.

6. Place the arm of the locking device on the sight head on "Gyro."

7. Find the central point for checking the sum total angles of lag and sight with a variation in the attack angles:

a) Set selector switches "NR-30-RS" in the position "NR-30"; "B-S in position "S"; and "N-DUAS" in position "N";

b) With the aid of the hand crank on the range finder, set the time to Tr=1 second on the dial of the computer;

c) By utilizing the adjustment screws of the KR5S-2 telescope, superimpose the axis of the telescope with the central point of the sight graticule.

8. Set the swtiches "N-DUAS" and "NR-30-RS" respectively in positions "DUAS" and "RS."

9. With the aid of the hand lever on the range finder, set the time to [P 83] Tr=3 seconds on the computer.

10. By turning the adjustment screw on the device establish precisely the zero position of the vanes of the sensor for the attack angles until a total angle equal to 1°13' is attained on the head of the sight.

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11. Unlock the planes of the device for the attack angle vanes of the sensor and by alternately deflecting it together with the vanes to angles 2°22' and 7°05', make sure that the total lag and sight angles indicated by the head of the sight correspond to the data given in the tables. With each shift in the position of the attack angle vanes of the sensor to angles of 2°22' and 7°05', it is necessary to lock the adjustable plane by means of the lock and the wing nut.

If the attack angle vanes of the sensor are deflected upward, the central point of the sight graticule is deflected downward; and when the vanes are deflected downward, the central point returns to its normal position.

The deflection of the central point when observed through the KP5S-2 telescope will be seen in reverse order to the position indicated in the text, because the telescope presents a graticule image rotated 180°.

12. After the attack angles are checked, the adjustable surface for the attack angle vanes of the sensor is set in a zero position by means of a lock and wing nut.

[P084]

Checking the Angles of RS Lag With

Variations in the Slip Angles

1. Check that the adjusting planes of the attack and slip angles on the device are locked in the zero position.

2. Establish a central point to check the angles of RS lag when a change of the slip angles occurs:

a) Set the selector switch "NR-30-RS" in position "NR-30"; switch "B-S" in position "S"; switch "N-DUAS" in position "DUAS";

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b) Using the adjustment screws of the KP5S-2 telescope, superimpose the axis of the telescope with the central point of the sight head;

c) Place the "NR-30-RS" switch in position "RS."

In switching the selector switch "NR-30-RS" from position "NR-30" to position "RS" (and back), and with the slip angle vanes of the sensor in the pricise zero position, the central point of the sight head should not be deflected from the axis of the KP5S-2 telescope. If this positioning is not attained, the zero position of the slip angle vanes of the sensor must be set with the aid of the adjustment screw on the device;

d) With the help of the crank of the manual range finder, set the time Tr=1.5 seconds on the computer dial.

3. Lock the plane of the device for the slip angle vanes of the sensor [P 85] and gradually deflect it together with the vanes to angles of ± 1°11', ±2° 22', and ±3°33', and make sure that the horizontal components of the RS lag angles attained by the sight head correspond to the data in the tables.

With each change in the position of the slip angle vanes of the sensor to angles 1°11', 2°22', and 3°33', it is necessary to lock the adjustment surface by means of a lock and wing nut.

When the slip angle vanes of the sensor are deflected to the left, thee central point of the sight graticule is deflected to the right; when the vanes are deflected to the right, the central point is deflected to the left.

The deflection of the central point, when observed through the KP5S-2 tube, will be seen in a position reversed to that indicated in the text, since the tube presents a graticule image rotated by 180°.

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4. Disconnect the sight, first arresting the gyroscope.

5. Lock the adjustment surface of the slip angle vanes of the sensor in the zero position by means of a lock and wing nut.

6. Unscrew the wing nut, take off the cover, and remove the device from the DUAS-8M, being careful not to damage the vanes of the DUAS-8M.

7. Upon completing the check, a metallic protective shroud should be placed on the DUAS-8M casing, while a protective canvas cover should be placed on the air pressure tube (PVD). [P 86]

If the readings of the total of the lag and sight angles are such that their accuracy is doubtful, then it is necessary to check the output accuracy of the nominal values of the relative voltage in percentages for the attack and slip angle sensor without the sight. For this it is necessary to:

a) Disconnect the electrical plug of the sensor through the hatch for the ARK frame antenna;

b) Connect the plug to a power supply and an instrument which will indicate the value of the output voltage, utilizing the wiring diagram for the DUAS (figure 17);

c) Deflecting the vane, check the correspondence of the output of the nominal value of the relative voltage in percentages in relation to the slip angle vane of the sensor;

d) Disconnect the checking instrument, connect the plug, and close the hatch of the frame antenna.

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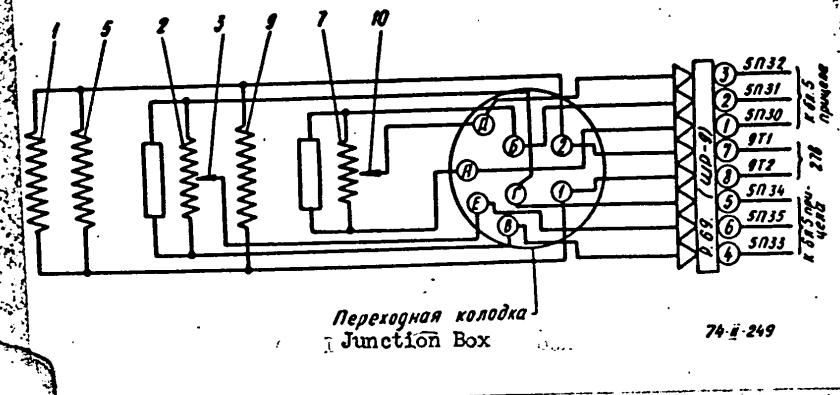

Фиг. 17. Принципиальная электросхема датчика ДУАС-8М.
1-обогрев ПВД; 2- потенциометр угла скольжения; 3- ползунок потенциометра; 5-обогрев датчика угла скольжения; 7- потенциометр угла атаки; 9- обогрев датчика угла атаки; 10- ползунок потенциометра.

Fig. 17. The principal circuit plan for the sensor DUAS-8M

1-heating element for PVD; 2-potentiometer of the slip angle; 3-sliding contact of the potentiometer; 5-heating element for the sensor of the slip angle; 7-potentiometer of the attack angle; 9-heating element of the sensor of the attack angle; 10-sliding contact of the potentiometer.

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[P 88]

CHAPTER II

TECHNICAL SERVICING OF THE CANNON ARMAMENT

1. General Information on the Gunnery System

The gunnery system of the plane consists of one NR-30 cannon located in the lower part of the right side of the fuselage with a basic load of 60 rounds of ammunition.

The cartridge belt is located in a ring-shaped sleeve-guide, secured between the fuselage and the fuel tank. During firing, the links are collected in this same sleeve, while the casings are ejected.

The gun feed track consists of separate sections-guides, which can be dismantled in case of necessity.

In order to prevent the possibility of the formation of a dangerous concentration of explosive powder gases, a gas exhaust device for the ejecting of the gases into the atmosphere is mounted on the gun.

Louvers are located in the barrel fairing and hatch covers, making it possible to draw off the powder gases from the gun compartment while in flight.

WARNING: When on the ground, firing is permitted only if the speed brakes are open and the fairing and hatch covers of the gunnery system are removed.

[P 89]

At the point where gases escape from the gun barrel, a steel shield which protects the fuselage skin from the effects of the

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high temperature of the ejected gases, is mounted on the fuselage.

A gas compensator, which is designed to eliminate the possibility of a pitching and turning moment while the gun is being fired, is installed in the furrow of the protective plate.

Fire control is accomplished by pressing a trigger clamp located on the button of the plane control stick. The same button is used for launching missiles and for firing rockets from the rocket pods.

In order to conduct aimed firing, firing sight ASP-5ND which operates together with the range only radar and the infrared sight SIV-2 is mounted on the plane.

Gun camera SSh-45-1-100-OS with timing mechanism VM-2 is mounted to monitor aiming.

The infrared sight SIV-52 is mounted in order to conduct aimed fire at night. In this case, the gun camera is removed.

2. The Reloading and Fire Control System (90)

Figure 18

The gun reloading system consists of an electric valve EK-48, an expendable air bottle, an air duct, and a reloading button.

The operational air pressure of the reloading circuit is 50 kilograms per square centimeter.

When the button is pressed, the current is transmitted to the electromagnet of the electricvalve, which in turn releases and transmits compressed air from the expendable bottle into the reloading cylinder of the cannon.

On release of the button, the electric valve is disconnected, the supply of compressed air is cut off, and the air which remains in the cylinder of

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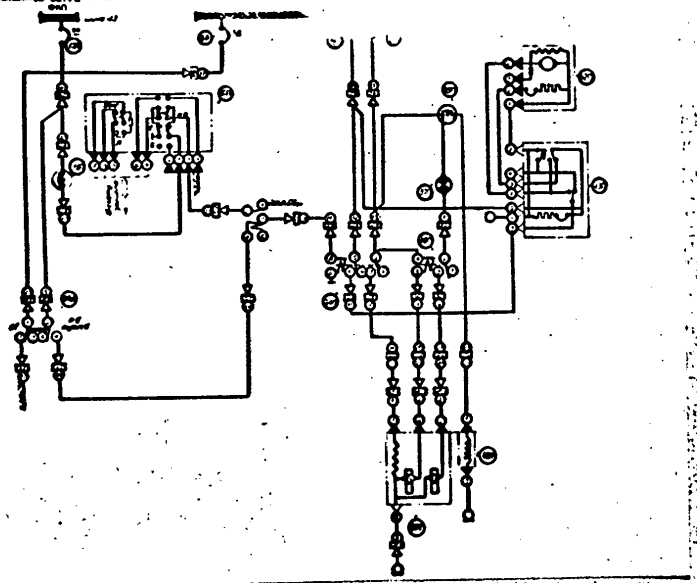

Fig. 18. The main feeder circuit diagram for reloading and fire control

Фиг. 18. Принципиально-фидерная электросхема перезарядки и управления огнем.

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Figure 18. The main feeder circuit diagram for reloading and fire control. (92)

6R-circuit breaker for the range only radar

16R-aiming control panel

17P-circuit breaker for the firing button

18P-firing button

19P-circuit breaker for the gun camera

24P-firing switch "RS. pushka-SS" ("RS, cannon-SS")

25P-circuit breaker for the cannon

27P-electric trigger of the cannon

28P-switch relay for the armament and the gun camera

37P-signal light for firing readiness of the gun

38P-signaling relay indicating readiness of the gun

39P-gun reloading button

40P-electric valve for gun reloading

42P-gun camera

43P-timing mechanism

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the cannon is released into the atmosphere between the reloading valve which is located on the forward mount, and the connecting duct of the reloading cylinder of the cannon.

Two sensors, a barrel sensor and a breech sensor, are located on the electric trigger of the gun to assure functioning of the system which signals firing readiness.

The light which signals firing readiness lights up only if the contacts of both sensors are closed.

When in a position of firing readiness, the gun barrel must be at an extreme forward position, and with the locking aggregate - on the single sear. This position of the barrel and the locking is monitored by the closing of the contacts, that is, the barrel and breech sensors which switch on the signal lamp.

The fire control system is a remote electric type and consists of an electric trigger, circuit-breaker, "Pushka," "NR, SS, RS, and FKP," a fire control relay, and a firing button. (93)

The control system allows the gun to be fired with or without the gun camera.

Selection of the type of action is determined by switching the gun control and the gun camera circuit-breaker.

The "Pushka" and "FKP" circuit-breakers are located on the right forward console.

The "NR, SS, RS, FKP" circuit-breakers are located under glass on the right rear console of the cockpit. The current from this circuit-breaker is transmitted to the firing button contact.

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When the firing button is pressed, the current from the circuit-breaker "NR, SS, RS, FKP" is transmitted to the firing control relay coil. The relay triggers and closes its contacts through which the current from the circuit-breaker is transmitted respectively to the electric trigger coil and the electric motor of the gun camera.

In all cases, it is necessary to set the switch "S-V" in position "S" and the switch "NR-30-RS" in position "NR-30" on the sight bracket before firing. It is impossible to fire the gun if the switches are in other positions, because the circuit which triggers the relay is broken, and, if the firing button is pressed, it fails to trigger the gun. The position of these switches has no effect on the operations of the gun camera.

The switch for operating the range only radar must be set in the position "RS, Pushka" ("RS, cannon") in order to fire the gun.

WARNING: It is impossible to fire the gun if the switch for operating the range only radar is in position "SS." It is not necessary to switch on the "SRD" circuit-breaker when the control circuits for all the armament systems are being checked on the ground.

The firing readiness of the gun and the expenditure of its basic load are monitored by a signal light. After the basic load is completely expended, the locking aggregate remains in a forward position, and the signal light does not glow.

In order to make sure that the basic load is fully expended, it is advisable to conduct reloading and release the units from the single sear.

If the signal light glows after reloading and is again extinguished after the button is pressed with no firing taking place, this means that the

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basic load is fully expended. This type of checking is permitted only in the air.

After the locking aggregate of the gun is checked by pressing the reloading button, it should again be set on the single sear.

It should be borne in mind that the signal light will not glow if the locking aggregate, after its release from the single sear, is in an intermediate position; a possibility when the cannon fails to fire.

3. CHECKING THE WORKABILITY OF THE RELOADING AND FIRE CONTROL SYSTEM

The workability of the reloading and fire control systems should be checked whenever the gun is being prepared for reloading. When checking it is necessary to make sure that the control system, the assembly, and the signal system are in good working order, and that there is no air leakage from the air reloading system.

A check of the workability of the control system should be carried out in the following order:

1. Open the main hatch of the gunnery system.

2. Open the circulating feed valve of the hydraulic system, set it on safety, and open the speed brakes manually.

3. Connect the aircraft circuit to a ground source of electrical energy, turn on the "plane-battery, airfield" switch, and make sure that the voltmeter indicates 28.5 ± 0.5 volts.

4. Check the pressure in the air system; it should equal 110-130 kilograms per square centimeter.

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5. Make sure that there are no cartridges in the feed mechanism of the cannon.

6. Connect the circuit-breaker "Pushka" ("Cannon").

7. Reload the connon; in order to do this, press the reloading button located on a panel on the upper left portion of the instrument board. To make sure of the dependability of the reloading mechanism, it is necessary to press the reloading button for a period of 2 to 3 seconds. Reloading should occur smartly.

8. Make sure that the signal light on the panel on the lower part of the instrument board lights up indicating the firing readiness of the cannon.

9. Set switch "S-B" in position "S" and switch "NR-30-RS" in position "NR-30" on the sight bracket. The position of the sight switches has no effect on reloading.

10. Check whether there are live cartridges in the breech claw through the casing ejection port.

11. With the aid of the firing button, release the locking mechanism of the cannon and make sure that the signal light indicating the firing readiness of the cannon is extinguished.

In order to shorten the time required for preparations, it is possible to check the workability of the gun camera SSh-45-1-100-OS with the timing mechanism VM-2 simultaneously while checking the operation of the fire control system. The method of checking is described in the section "Technical Servicing of the Gun Camera."

After checking of the workability of the reloading and fire control system, it is necessary to disconnect the circuit-breaker, the battery,

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and complete all other tasks to prepare the cannon for firing, according to the mission.

4. CHECKING THE CARTRIDGES AND LINKS, AND THE LOADING OF CARTRIDGE BELTS BEFORE THEY ARE LOADED IN THE AIRCRAFT

All cartridges and links, before being loaded into the cartridge belt, must be thoroughly inspected.

Cartridges and links with the following defects must not be placed in the cartridge belt:

1. Damaged or rotating fuze membrane
2. Loose false ogive
3. Cracks in the mouth of the shell casing which are visible to the naked eye
4. Rotation and longitudinal looseness of the shell in the casing.
5. Massive corrosion of the percussion cap, shell and links.
6. Fuze corrosion at the spot where the membrane is pressed.
7. Improper seating of the percussion cap.
8. Dents in the cartridge casing
9. Links which are cracked or are elongated, and links which have been used more than three times

The gap between the hook and the cartridge casing should not exceed 3.5 millimeters (figure 19).

It is forbidden to load the cartridge belts with cartridges which were previously in the automatic mechanism of the gun, and cartridges which are not documented. (99)

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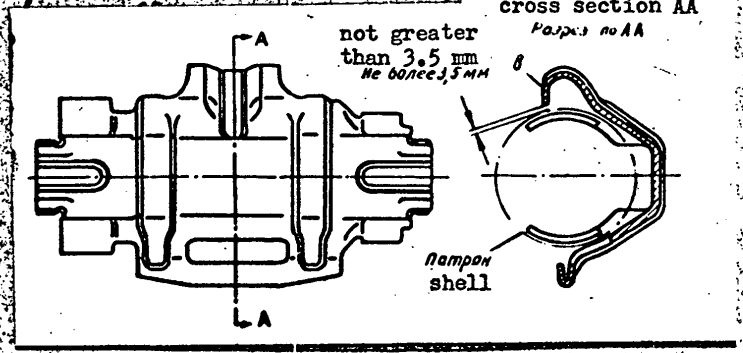

Фиг. 19. Схема замера зазора между крючком звена и гильзой патрона

Fig. 19. Diagram for measuring the gap between the hook of the link and the shell casing

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The loading of the cartridge belt is carried out with a special machine which should provide smooth loading of the belt without damage to the cartridges and links.

When the necessity arises for loading individual cartridges into the belt, such loading is carried out by means of a special device.

It is necessary to check the belt links for displacement in relation to the shell casing before it is placed in the feed track. In the case of link displacement it is necessary to align the belt in such a manner that the front claws of each link rest against the declivity of the cartridge casing. Belt alingment is carried out by striking the front end of the link with the soft side of the hammer.

WARNING: When loading and aligning the belt, do not dent the cartridge or strike the percussion cap or fuze with the hammer.

Cartridges which are a part of the plane's ammunition may be lubricated slightly with the same lubricant that is used for the gun.

To prevent gun failure because of dirty shells, it is necessary to use cartridges for firing which do not have sand, corrosion, or other types of dirt on their surface.

A clean piece of cloth may be used to remove corrosion products from the surfaces of the cartridges.

5. LOADING THE GUNNERY SYSTEM

General Aspects

Each individual case of gun loading, depending on the mission, has its own characteristics. The knowledge of these characteristics makes it possible to shorten considerably the time used in preparing the gun for

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firing. Most typical cases of gun loading are:

1. Loading the gun with a complete basic load.

2. Loading the gun for practice firing.

3. Loading the gun after the complete expenditure of a basic load.

4. Loading of the gun in the case when a complete basic load was not expended.

Loading is to be conducted only after the workability of the gun assembly and the technical condition of the gunnery system have been checked, and the loading and fire control system have been tested. The order in which these checks and tests are carried out is described in the subsequent sections of these instructions.

Prior to loading, it is necessary to establish whether or not there are any cartridges in the gun and feed track, disconnect all the circuit-breakers, and set the detainer for switching on the firing button on the handle of the aircraft control stick in an upper-travelling position. (101)

The final loading of the gun for firing is permitted only by the pilot reloading when the aircraft is in the air.

On the ground, the gun should not be fully loaded; that is, it is to be in a position in which the final loading "for firing" requires only the pressing of the reloading button. It thus follows that loading should be conducted when the movable parts of the gun are in a forward position. In this case, the housing of the feed mechanism should be closed. The ammunition is pulled through the feed track by means of a winch (Fig. 20) mounted on the shell casing ejection part of the gun.

In all cases the loading and unloading of the gun is carried out with

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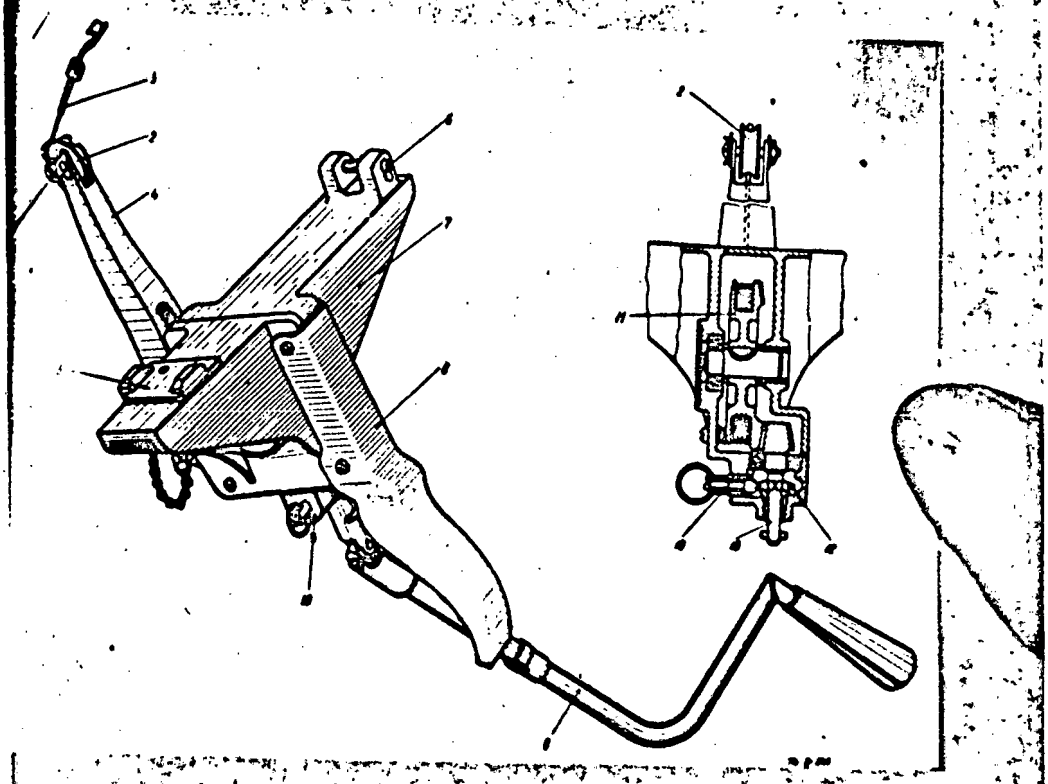

I- ограничитель; 2- направляющий ролик;
3- трос; 4- качалка; 5- направляющая; 6- штифт;
7- корпус; 8- кронштейн; 9- рукоятка с кронштейном
10- стопор; 11- шестерня-барабан; 12- храповик;
13- ведущая шестерня.

Fig. 20. Winch for feeding the cartridge belt

1-limiter; 2-guiding roller; 3-cable; 4-rocking arm; 5-guide; 6-pin; 7-casing; 8-bracket; 9-handle; 10-stopper; 11-gear drum; 12-ratchet; 13-master gear.

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the strict observance of the prescribed safety measures.

The number of cartridges in the catridge belts which are ready to be placed in the plane must correspond to the number prescribed. Single empty links must be connected to the beginning and end of the belt.

WARNING: Only a single empty link must be in position at the beginning of the belt when the gun is being loaded. The addition of an additional number of links to the beginning of the belt is not permitted.

While inspecting the ammunition prior to loading it aboard the aircraft, particular attention should be paid to the correct alignment of the belt. It requires considerable effort to pull a poorly aligned belt through the feed track.

LOADING AN UNLOADED GUN WITH A COMPLETE BASIC LOAD

If the gun is unloaded and there is no ammunition on the plane, loading is carried out in the following manner:

1. Open the gun access hatch, the speed brakes, and the cover of the feed sleeve and remove the lower guide unit.

2. Check the technical condition of the gunnery system and the workability of the reloading and fire control system.

3. Make sure the receiver mechanism housing cover is closed, and when convinced that there are no cartridges in the breech, lower the locking assembly from the single sear.

4. From the side where the cartridge belt is serviced (through the servicing chute) place the device for pulling the winch cable, with the plate forward, and push it through the entire feed tract to the cannon.

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5. Mount the winch, for pulling the cartridge belt, on the cartridge casing ejection port of the gun.

6. Connect the winch cable which is passed over the bracket pulley under the housing of the gun receiver mechanism port to the opening of the plate device (figure 21) and pull the device together with the winch cable to the servicing chute; the device is then separated from the winch cable.

7. Bring up the ammunition and connect the hook of the winch cable to the first link of the cartridge belt. To facilitate installation of the cartridge belt into the feed track it is advisable to place it into a wooden tray, which is as long as the belt, located under the plane.

The cartridge belt is fed into the gun receiver mechanism housing by the hook of the link; the first link in this case must contain no cartridges.

8. Connect the hook of the connector with the eye of the last (empty) link of the cartridge belt.

9. Turning the winch handle in a clockwise direction, pull the cartridge belt through the entire feed track to the gun (figure 22), and, without opening the receiver mechanism housing, guide the forward end of the belt into the gun's receiver until a slight click is heard.

Make sure that the ends of the first empty link (without cartridges) of the belt touches the link extractor guide.

The cartridge belt should be supported by the hands and guided into the servicing chute when it is being pulled by the winch.

If noticeable effort is required to turn the handle of the winch, the pulling must be halted and the reason for the belt friction in the

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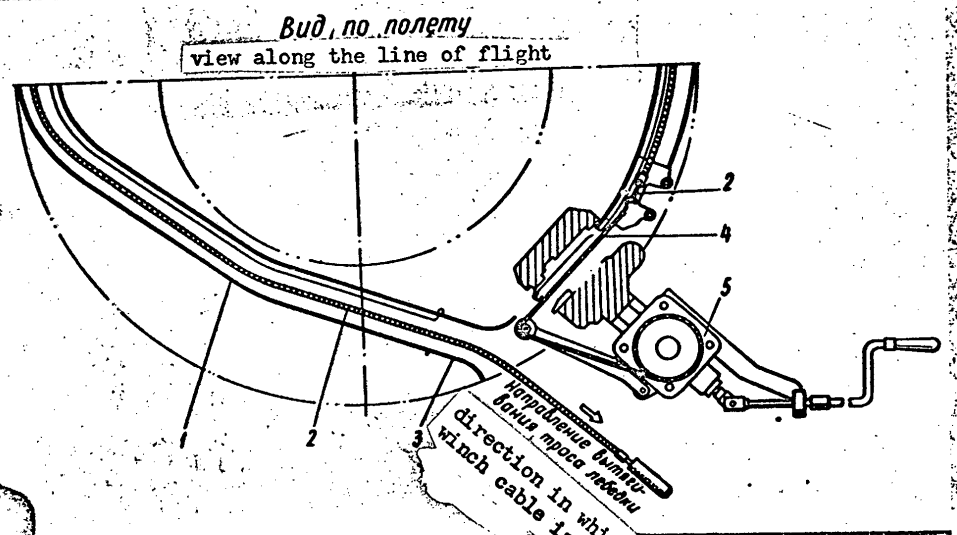

Фиг. 21. Соединение троса лебедки с приспособлением.
1-трап питания; 2-приспособление для протаскивания троса лебедки;
3-направляющий рукав; 4-трос лебедки; 5- лебедка.

Fig. 21. Connection of the winch cable with the device.

1-feed chute; 2-device for pulling the winch cable;
3-guiding sleeve; 4-winch cable; 5-winch.

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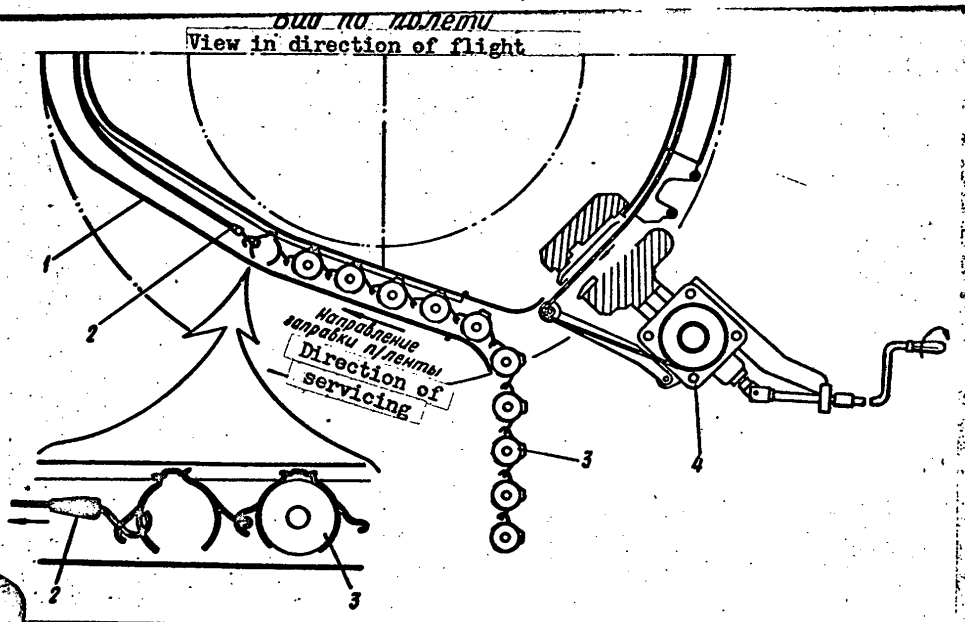

Фиг. 22. Заправка патронной ленты.
1-тракт питания; 2-крючок троса лебедки;
3-патронная лента; 4-лебедка.

Figure 22. Servicing the Cartridge Belt
1. Feed chute; 2. Hook on winch cable;

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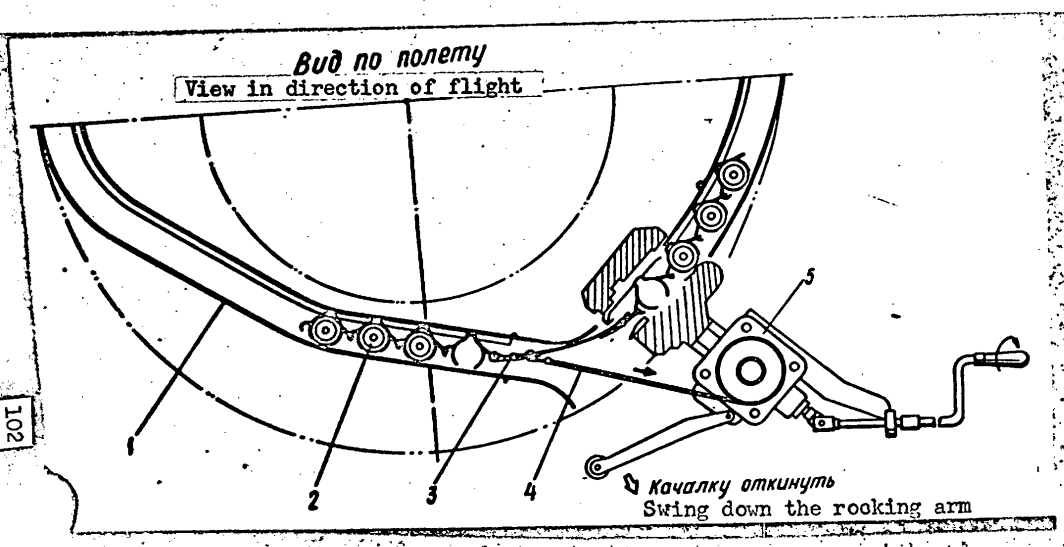

Figure 23. Joining the Ends of the Cartridge Belt
1. Feed chute; 2. Cartridge belt; 3. Connector;

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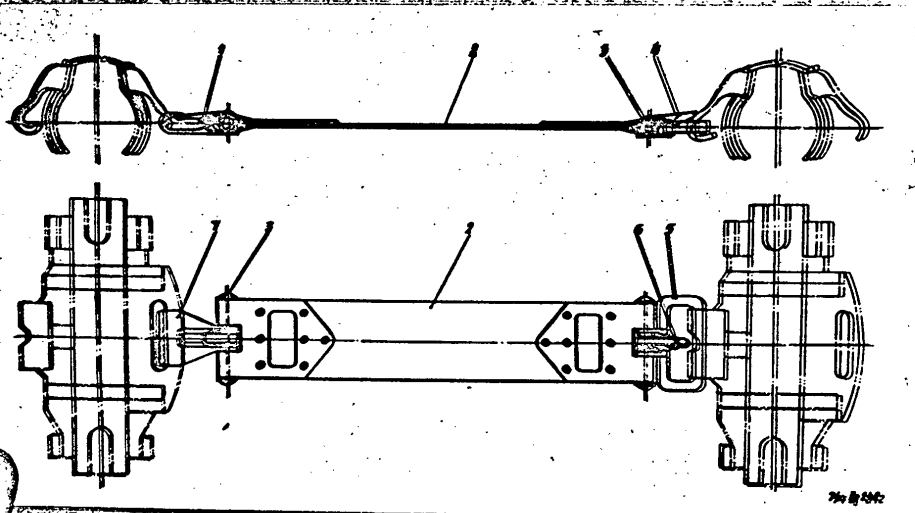

Фиг. 24. Соединитель патронной ленты.
1-пружина защелки; 2-лента; 3-валик; 4-защелка;
5-петля; 6-пружина защелки; 7-крючок.

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Figure 24. Cartridge Belt Connector
1. Spring catch; 2. Belt; 3. Roller;

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feed track must be clarified. This may be the result of a poorly aligned [p 107]
cartridge, some obstruction, or deformation of the feed track.

In this case it is necessary to slacken the winch cable, pull back part of the belt, correct the links and the misaligned cartridges, and continue the loading. If friction on the cartridge belt continues while it is being pulled, that part of the belt must again be pulled out and the feed track inspected for the presence of foreign objects or damage which must be corrected before loading is continued.

10. Disconnect the winch cable from the link of the cartridge belt, remove it from the roller of the winch rocker arm, and swing the rocker arm downward.

11. Connect the hook of the winch cable with the opening of the cartridge belt connector.

12. Turning the winch handle in a clockwise direction, pull the cartridge belt until it is possible to join the eyelet of the connector with the hook of the first link in the cannon receiver; the belt is then linked. (Figures 23 and 24)

13. Following the linking, the handle is turned counterclockwise, the winch cable is slackened, and the winch is removed from the case ejection port of the gun.

14. Set the lower link guide in place and close the cover of the [p 110]
guiding sleeve, the speed brakes, and all the cannon access hatches.

It must be kept in mind when loading that the hook as well as the eyelet of the connector are placed on the link of the belt with their safety catches toward the inside of the feed chute.

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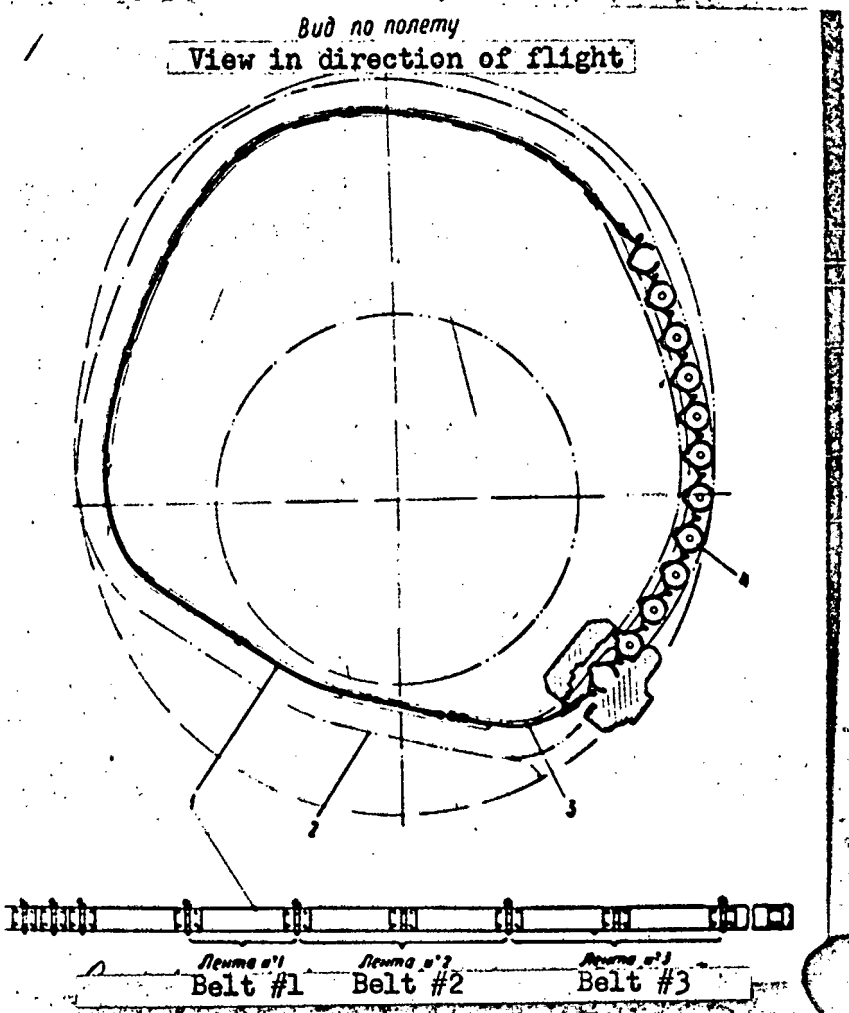

Фиг. 25. Патронная лента для учебных стрельб.
1-соединительная лента; 2- лоток-питатель;
3-соединитель; 4-патронная лента.

Figure 25. Cartridge Belt for Practice Firing
1. Coupling belt; 2. Feed chute; 3. Connector;
4. Cartridge belt

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The correct tension on the cartridge belt is determined by the position of the fourth cartridge, counting from the feed mechanism of the cannon, and by the absence of sagging at the visible ends of the cartridge belt. With proper tension the fourth cartridge should press closely against the guide feed chute.

Slack may occur only as a result of the belt being stretched due to its being packed with more cartridges than prescribed or by the presence of stretched links.

Loading the Cannon for Practice Firing

Fire units consisting of 10, 15, 20, and 30 cartridges are used when the cannon is loaded for practice firing. A metal coupling belt consisting of several link strips connected by hinge pins is used for loading this number of cartridges (Figure 25). The pins of the coupling belt are used to change the length of the belt when cartridge belts containing different numbers of cartridges are used.

In loading a fire unit consisting of: [p 112]

1. 10 cartridges, the full length of the coupling belt is used;
2. 15 cartridges, one link is removed from the coupling belt;
3. 20 cartridges, two links are removed from the coupling belt;
4. 30 cartridges, #2 and #3 links are removed from the coupling belt.

The cartridge belt must have an empty link at each end.

The loading order and all recommendations and warnings mentioned in the section "Loading an Unloaded Cannon With a Full Fire Unit" apply when the cannon is loaded for training purposes. The differences are as fol-

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lows:

1. Depending on the number of cartridges to be loaded, it is necessary to determine the length of the coupling belt and connect its hook with the last (empty) link of the cartridge belt.

2. The hook of the connector is joined to the eyelet of the metal belt.

3. The movement of the cartridge belt as it is pulled by the winch into the cannon must be supported by the coupling belt until the first empty link enters the receiver of the cannon.

The hook of the connector is linked with the eyelet of the first link of the cartridge belt in the same manner as when the cannon is loaded with a full fire unit.

Loading the Cannon After Complete Expenditure of a Fire Unit [p 113]

Loading the cannon after expenditure of a complete fire unit is conducted either when the cannon is being prepared for firing for another flight or is being serviced with a full fire unit after practice firing.

Unlike the examples cited above, the task of loading in this case may be carried out simultaneously while unloading for the purpose of saving time.

Loading is conducted while observing established safety measures and using the following procedure:

1. Carry out the instructions in paragraphs 1 to 10 of the section "Unloading the Cannon After Expenditure of a Complete Fire Unit."

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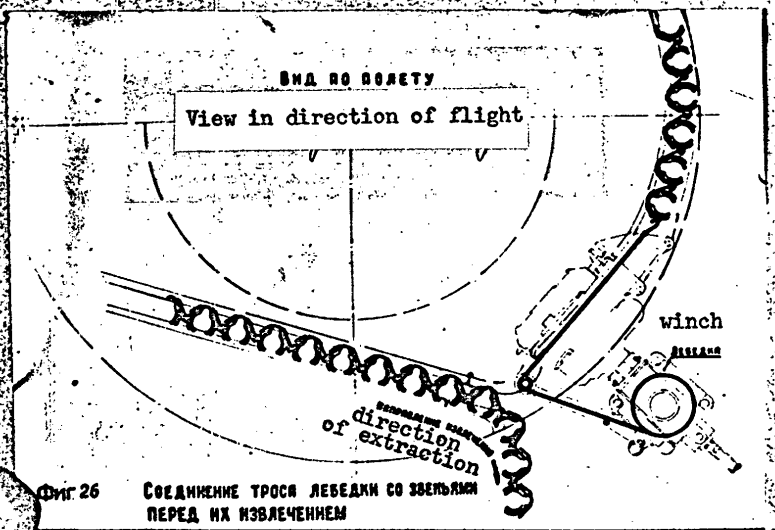

Фиг 26 Соединение троса лебедки со звеньями перед их извлечением

Фиг. 26. Соединение троса лебедки со звеньями перед их извлечением.

Figure 26. Joining the Winch Cable With the Links Prior to Their Extraction

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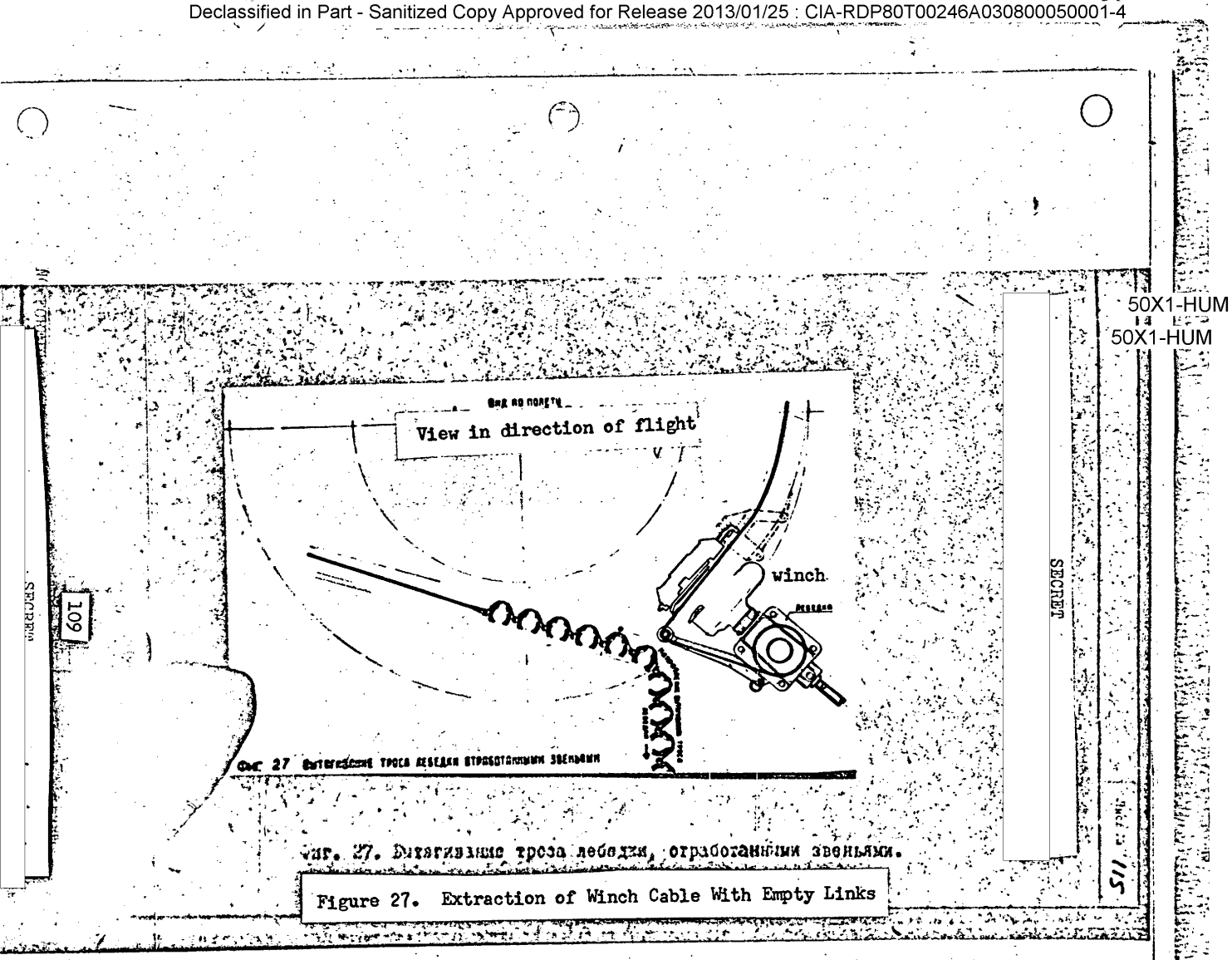

Фиг. 27. Вытягивание троса лебедки, отработанными звеньями.

Figure 27. Extraction of Winch Cable With Empty Links

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2. Place the cable on the roller of the rocker arm of the winch and connect it to the first link of the belt (Figure 26).

3. Pull out the cartridge belt with all the links and the winch cable from the belt servicing side (Figure 27). It is necessary that the winch cable remain tight at all times.

Proceed in the manner described in paragraphs 7 to 14 of the section "Loading the Cannon With a Full Fire Unit." [p 116]

Supplementing the Cannon's Fire Unit When Ammunition is Not Fully Expended

Supplementing the cannon with ammunition in the case of incomplete expenditure of its fire unit is permitted only after the cannon is completely unloaded.

Unloading is carried out in the manner described in the section "Unloading the Cannon When its Fire Unit is Not Fully Expended."

After the cannon is unloaded it is necessary to:

1. Disconnect the free links and the connector from the remainder of the belt.

2. Check the condition of the remaining part of the cartridge belt.

3. Add to the remaining part of the belt a sufficient number of cartridges to load the belt.

4. Attach the winch cable to the first link of the cartridge belt, guiding the belt toward the servicing tray of the feed chute; load the gun according to the instructions.

In a number of cases, depending on the number of cartridges expen-

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ded, it is advisable to feed into the feed chute a newly prepared cartridge belt, using the remaining unused cartridges for practice firing.

Unloading the Cannon [p 117]

(General Aspects)

The more characteristic situations which require unloading the cannon are:

1. when the fire unit is fully expended;
2. when the fire unit is partially expended;
3. when the fire unit was not fired during the flight (no firing was done);
4. because of an uncorrected fault during the flight.

While each of these cases has its own characteristics, all of them have a number of aspects in common which are necessary to consider in unloading the cannon.

No work should be undertaken on the aircraft after landing until safety precautions for the prevention of accidental firing have been taken.

For the purpose of inspection and unloading of the cannon after it is fired in the air, it is necessary to place the nose section of the aircraft in a safety zone. It is categorically forbidden to stand in front of the barrels.

A red flag should be placed in front of the barrels at a distance of 3 to 5 meters from the plane as a warning that passage near the plane in the area of the barrels is forbidden; a red lantern is used for this purpose at night. [p 11

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It is first necessary to turn off the circuit breaker of the fire control system and inspect the condition of the locking assembly of the cannon.

It should be remembered that if the locking assembly of the cannon is found to be in the forward position, it is possible that the cartridge chamber contains a live cartridge and not merely a casing (due to a misfire or for other reasons.) It is therefore necessary to first make sure that air pressure is adequate before the cannon is reloaded; the air pressure in the armament air system should equal not less than 40 kg/cm^2.

All access hatches to the cannon and the speed brakes must be opened before unloading the cannon.

Unloading the Cannon Following Complete Expenditure of the Fire Unit

With a complete expenditure of the fire unit, the locking assembly of the cannon with the cartridge casings in the breech extractor are in a forward position. In this case, removal of the cartridge casings and links should be carried out in the following order:

1. Turn on the circuit breaker "Cannon" and, after pressing the button, proceed with the reloading. After reloading is completed, the locking assembly must stand on a single sear.

2. Disconnect the locking mechanism of the housing of the feed mechanism and lift it by hand.

3. Push the cartridge casing or cartridge upward from the breech extractor and eject them through the cartridge casing ejection port of [p 119]

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the cannon.

WARNING: In order to avoid striking the percussion cap in all cases of extracting the cartridge from the breech extractor, caution should be exercised so that the cartridge is not dropped.

4. Open the cover of the guiding sleeve.

5. Remove the lower leading link.

6. Place the winch on the cartridge casing ejection port of the cannon.

7. Through the opening of the guiding sleeve, pull the belt by the hook along the feed chute in such a manner that the connector hook emerges from the cannon receiver.

8. Connect the hook of the winch cable to the second link of the connector.

9. Turning the handle of the winch in a clockwise direction, disconnect it at the place where the link is joined with the hook of the connector. To prevent turning of the belt in the feed chute when it is tightened by the winch, it is necessary to hold it with a screw driver placed in the connector opening near the eyelet.

10. Turning the handle of the winch counterclockwise, slacken the belt links and unhook the winch cable.

11. Place the cable on the roller of the rocker arm of the winch and connect it to the connector hook of the cartridge belt.

12. Extract the belt together with the connector and the winch cable by hand from the belt service side. It is essential that the winch cable remain taut while the links are being extracted. [p 120

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13. Following the extraction of the links, the winch cable should be disconnected from the connector and the connector from the link of the belt. The winch cable will thus be ready to service another fire unit.

14. Having ascertained that no cartridges remain in the breech extractor, lower the locking mechamism from the sear, having first closed the housing of the feed mechanism.

If servicing a new fire unit is not required, the cable should be wound on the drum of the winch and the cover of the guiding sleeve, the lower link guide, and the hatch for the cannon assembly should be closed.

Unloading the Cannon When the Fire Unit is Not Fully Expended

The connector is located in an inaccessible position and cannot be unhooked from the belt.

In the case of incomplete expenditure of the fire unit and the absence of an impediment, the locking assembly should be on a single sear with a cartridge in the breech extractor. The barrel of the cannon must be in the extreme forward position. Having checked the position of the barrel and the locking mechanism, the unloading should proceed in the following order:

1. In order to prevent accidental discharge, insert a screw driver [p 121 in the cartridge chamber of the barrel, placing it at the edge of the opening of the barrel housing and on the lug of the casing.

2. Remove the lower and upper link guides.

3. Depress the catch of the housing of the feed mechanism of the

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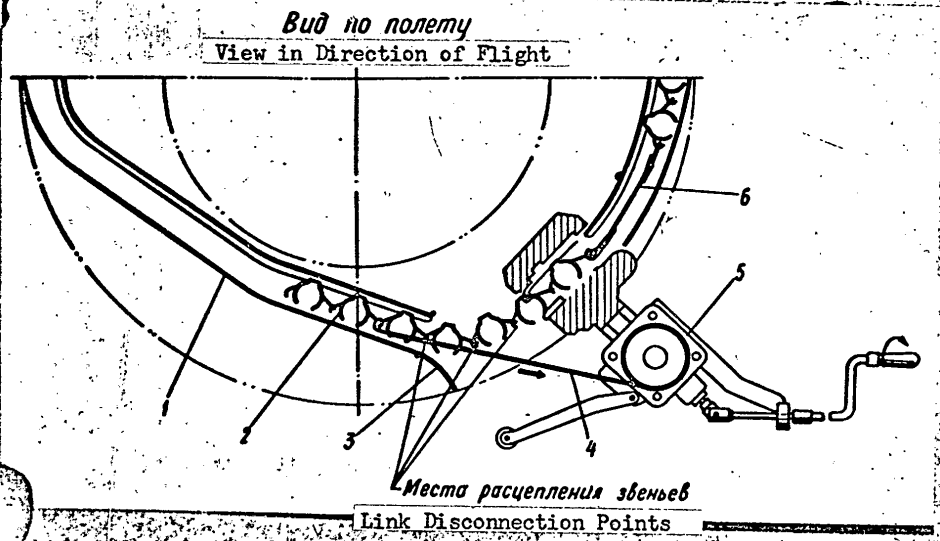

Рис. 28. Расцепление звеньевой ленты.
1—тракт питания; 2—звеньевая лента; 3—заправочный лукав;
4—трос лебедки; 5—лебедка; 6—соединитель.

Figure 28. Disconnecting a Link Belt
1. Feed chute; 2. Link belt; 3. Servicing tray;
4. Winch cable; 5. Winch; 6. Connector

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cannon and raise it by hand.

4. Extract the cartridge from the belt extractor and remove the screw driver from the cartridge chamber. Close the cover of the feed mechanism.

5. Place the winch over the cartridge ejection aperture of the cannon.

6. Open the lid of the feed chute.

7. Connect the cable of the winch by its hook to the fourth or fifth link from the cannon.

8. Turning the handle of the winch clockwise, tighten the belt in order to assure the possibility of disconnecting the links located between the cannon and the hook of the winch cable, after which the belt may be disconnected (Figure 28).

9. Turning the winch handle counterclockwise, release the tension on the belt and disconnect the winch cable.

10. Place the cable on the rocker arm of the winch and connect it to the link located in the cannon receiver. Tighten the cable slightly by using the winch handle.

11. Depress the catch on the housing of the feed mechanism and raise it by hand.

12. Carefully extract through the servicing tray the remainder of the cartridge belt with the expended links, the connector, and the winch cable. The remainder of the belt may be removed by means of the winch handle. [p 123]

The remainder of the extracted belt should be laid in a box prepared

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for this or should be placed on a tarpaulin.

13. Disconnect the winch cable from the cartridge belt and, if servicing a new fire unit is not required, wind the cable around the winch drum and remove it from the extractor port of the cannon.

14. Lock the catch on the housing of the cannon feed mechanism and, after ascertaining that there are no cartridges in the extractor, release the locking assembly from the sear notch.

15. Replace the upper and lower link guides. Close the cover of the guiding sleeve, all hatches, and the speed brakes.

Unloading the Cannon When the Fire Unit Was Not Used During Flight (Firing Was Not Conducted)

In practice, the following examples of this type of unloading are most frequently encountered.

1. Unloading a cannon which has not been reloaded.

2. Unloading after reloading has occurred.

A cannon which has not been reloaded is dismantled as for cleaning according to the following sequence:

1. Ascertain from the position of the movable parts and the presence of an empty link in the cannon receiver that the cannon has not been reloaded. [p 124]

2. Remove the lower link guide.

3. Place the winch on the cartridge casing ejection port of the cannon and attach the cable hook to the opening in the cartridge belt connec-

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tor.

4. With the aid of the winch, tighten the cartridge belt and disconnect the eyelet of the connector from the hook of the first (empty) link located in the cannon receiver.

5. Turning the winch counterclockwise, release the tension and disconnect the winch cable from the eyelet of the connector.

6. Remove the winch from the cartridge casing ejection port of the cannon.

7. Depress the catch and open the cover of the cannon feed mechanism.

8. Open the cover of the guiding sleeve and extract the end of the cartridge belt from the receiver to the degree necessary to provide easy removal of the cannon.

If necessary, the belt may be withdrawn from the service tray in order to connect the first empty link with the winch cable for subsequent loading after mounting the cannon.

In practice, situations may arise where after reloading (i.e. putting the cannon in a ready state) firing in flight does not occur.

After reloading, the locking assembly with the cartridge in the bolt extractor is in the rear position on a single sear.

WARNING: Storage of the cannon with a cartridge in the bolt extractor is categorically forbidden. [p 125]

In contrast to the foregoing case, unloading should be begun by removing the cartridge from the bolt extractor.

Before unloading, measures should be taken to prevent an accidental discharge. Note the position of the locking assembly, turn off the cir-

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cuit breaker for the cannon armament, and place a screw driver in the receiver of the barrel.

Before loading again it is necessary to:

a. Place the winch over the cartridge casing ejection port of the cannon, close the feed mechanism housing, and connect the winch cable to the first link of the belt.

b. Extract a portion of the cartridge belt from the feed chute through the belt servicing tray and detach the connector from it.

v. In order that the length of the belt and the number of cartridges in it remain unchanged, it is necessary to add one link and a cartridge to the end of the belt. There should be one empty link after this addition to the end of the cartridge belt.

Unloading After an Uncorrected Inflight Malfunction

In order to determine the nature of an uncorrected inflight malfunction it is necessary to carefully inspect the position of the moving parts of the cannon, the next cartridge, the cartridge casing (if it has not been ejected), the links, and the condition of the cartridge belt at the entrance to the feed mechanism.

If the uncorrected inflight malfunction was not due to a failure of [p 126] the weapon but was due to faulty electrical and pneumatic control systems, the electric valve, pilot error, etc., it is necessary after inspection to reload the cannon pneumatically to seat the locking assembly on the sear.

If the locking assembly then seats on a single sear, further unloading is conducted as in the case of unloading a partially expended fire unit.

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When the locking assembly is at an intermediate position and does not seat on a single sear during pneumatic reloading, then, for the purpose of preventing an accidental discharge, it is necessary to hold the tip of a screw driver in the cartridge chamber or between the firing pin and the bolt. Further unloading (the elimination of the failure) should be conducted only under this condition.

When the moving parts of the cannon are jammed in the forward or any intermediate position, it is categorically forbidden to attempt to clear the cannon by striking the shell casing through the barrel with a cleaning rod, since there may be a live round rather than a casing in the bolt which could explode upon being struck.

In cases where the round has become separated and the projectile remains in the barrel, it can be dislodged by hand with a reamer on which is a special conical socket which protects the percussion cap from damage.

The dismounting of an unloaded cannon is permitted only in those [p 127 cases when the cannon cannot be unloaded in the plane.

To eliminate a malfunction it is first necessary to:

1. Take measures to prevent the moving parts from coming into contact with the shell in the forward position.

2. Remove the lower link guide.

3. Place the winch on the receiver opening of the cannon and disconnect the empty links.

4. Open the cover of the feed mechanism of the cannon and extract the cartridge belt from the receiver. If it is impossible to extract the belt, it should be disconnected at the entrance to the receiver.

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5. Remove the fire unit from the feed chute; after this it will be possible to begin extracting the jammed shell or casing.

If necessary, the handle of a mallet may be placed at the rear of the shell or casing and struck with a hammer in order to force it into the shell casing extractor opening of the cannon.

7. DISMOUNTING AND MOUNTING THE CANNON

The cannon is dismounted for the purpose of inspection, cleaning, and repair and to perform periodic maintenance. The dismounting is accomplished in the following order:

1. Lower the speed brakes, open the hatches of the cannon compartment, and remove the barrel fairing.

2. Examine the position of the moving parts and make sure that there [p 128] is no shell in the bolt extractor. If a shell is present, unload the cannon before dismounting.

3. Undo the safety lock and disconnect the plug connector which connects the aircraft circuit with the electric wiring of the cannon's electrical release mechanism.

The cannon should be dismounted together with the electrical plug and wiring plate.

4. Remove the gas deflector housing. In order to do this it is necessary to extract the stop catch from the groove in the nut, unscrew the nut of the gas deflector, and move it rearward along the barrel together with the housing.

5. Unscrew the gas exhaust.

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6. Remove the pin of the barrel attachment yoke and unhook half of the yoke.

7. Remove the lower and upper link guides.

8. Unscrew the set screw which holds the cannon in the front mount so that the screw comes out of the opening of the spherical support attached to the cannon.

9. Remove the safety pin from the fastening bolt of the front mount and loosen the nut to the degree necessary to freely rotate the bolt while pulling it through the slot of the half-yoke.

Holding the cannon by hand, disconnect and remove the movable part of the front mount.

10. Pull the cannon to the side so that the spherical insert may be withdrawn from the resting hole in the body of the front mount and push the cannon forward until the shaft of the back plate emerges from the spherical insert of the rear mount. [p 129

11. Lower the cannon and free it together with the gas exhaust from the fuselage.

The cannon is mounted in the reverse order. The following points should be noted:

a. While tightening the bolt of the front mounting collar be sure that the set screw of the ball support of the cannon is not forced.

b. To prevent the possibility of the gas deflector nut becoming unscrewed, carefully check the functioning of the spring and be sure that the catch is closed.

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8. CLEANING AND OILING THE CANNON

Timely cleaning and oiling of the weapon will assure the preservation of its firing capabilities and unfailing operation under various conditions of use, increase the life of the components and protect them from harmful corrosion.

The cannon must be cleaned in the following instances:

1. After firing.

2. After flight without firing.

3. After the plane has been standing without being flown for 10-15 days.

Depending on the nature of the flight mission and firing, the following amount of cleaning is required: [p 130]

1. Cleaning without dismantling -- the cannon is not removed from the aircraft.

2. Cleaning with partial dismantling -- the cannon is dismounted and taken apart by units. The units are cleaned, dried, inspected, and oiled in an assembled state.

3. Cleaning with complete dismounting -- the cannon is taken from the mounting and completely dismantled along with all its pieces and all pieces are carefully cleaned and inspected.

As a rule, cleaning of the cannon is conducted without dismounting after flight without firing.

After firing, the cannon is cleaned on the day of use with partial dismantling. As an exception, cleaning may be done on the following day.

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However, in this case cleaning of the cannon after firing should be done without taking it from the mounting.

Cleaning with complete dismantling is mandatory:

1. When the cannon is depreserved.

2. In conformance with routine maintenance procedures on the plane after 100 hours of flight.

3. After repeated malfunctioning for one reason or another.

4. After firing 500 rounds.

Dismantling of the cannon is carried out in accordance with the technical description and directions for its fulfillment.

For cleaning the cannon without removing it from the mounting, it [p 131] is necessary to unload it. Place the locking assembly in the rearmost position by reloading, open the feed mechanism, wipe the breech and bolt, seat the locking assembly on a single sear and wipe it from above.

Then oil the locking assembly and, after placing it in the rear position, oil the inside of the breech. In order to distribute the oil evenly, reload several times with the parts and sear notch lowered.

Wash dirt and scale from the parts in warm soapy water or kerosene. After washing, dry all components. Washing the electrical release mechanism is forbidden.

Rust should be removed with a rag dipped in kerosene or with a wooden stick. If the rust cannot be removed using these methods, then it is necessary to use pressed charcoal, placing some on an oiled rag which is then used to wipe the affected area. The indentations which remain after removal of the rust should always be greased.

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When cleaning the cannon without dismounting and it is not taken out of the plane, the barrel is cleaned only through the muzzle; in this instance, the locking assembly should be located in the rearmost position without a round in the bolt extractor.

The rubbing surfaces of parts which operate under great pressures should be greased more liberally.

In all cases when the aircraft is in a ready state, the weapons should be oiled with a low-temperature oil. The oil should be applied only to a well-cleaned, dry surface immediately after cleaning. [p 132]

Oil should be applied in a very thin film, wiping the pieces with a rag or brush soaked in oil and then well squeezed out.

Thicker layers of lubricant should be applied to the following lug on the crosspiece of the cannon breech for cocking the spring of the electrical release mechanism, the lower arm of the release lever, and the axis of the drive lever.

Since powder gases ejected into the atmosphere from the gas recoil mechanism come into contact with the internal cylindrical surface of the sleeve, the latter should be cleaned with a wire brush fastened to a reamer. The above components are part of the individual accessories of the cannon.

Under combat conditions deposits are not removed from the gas assembly components. Under training conditions deposits are removed from the gas assembly components at the direction of the group engineer but not more frequently than after 250 firings, and with fewer firings -- not more frequently than once a month.

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The deposits are removed with the aid of a special instrument (a wire brush, a scraper with key, a cylinder reamer) which is supplied with the cannon.

The gas assembly components as well as the chrome plated exterior surface of the barrel are not oiled after cleaning.

Cannons removed from planes for prolonged storage should be preserved and stored together with their individual spare parts. [p 133]

9. CHECKING THE CONDITION OF THE TECHNOLOGICAL JOINTS AND DISMOUNTING PARTS OF THE CANNON FEED CHUTE

The feed track consists of four parts: the guide profile, the feed chute, the upper and lower link guides, and the servicing tray (Figure 29). If necessary, any portion of the feed track may be disconnected.

Part of the guide profiles at places where they are connected have special technological joints whose condition must be inspected during operation.

Checking the Condition of the Technological Joints of the Cannon Feed Track

The cannon feed track has four technological joints. These joints are located at the following positions: the first joint is under the lower panel of the tank bay. Access to the joint is provided through a hatch on the exterior of the fuselage and a hatch for the servicing tray under the cover of the fuselage hatch.

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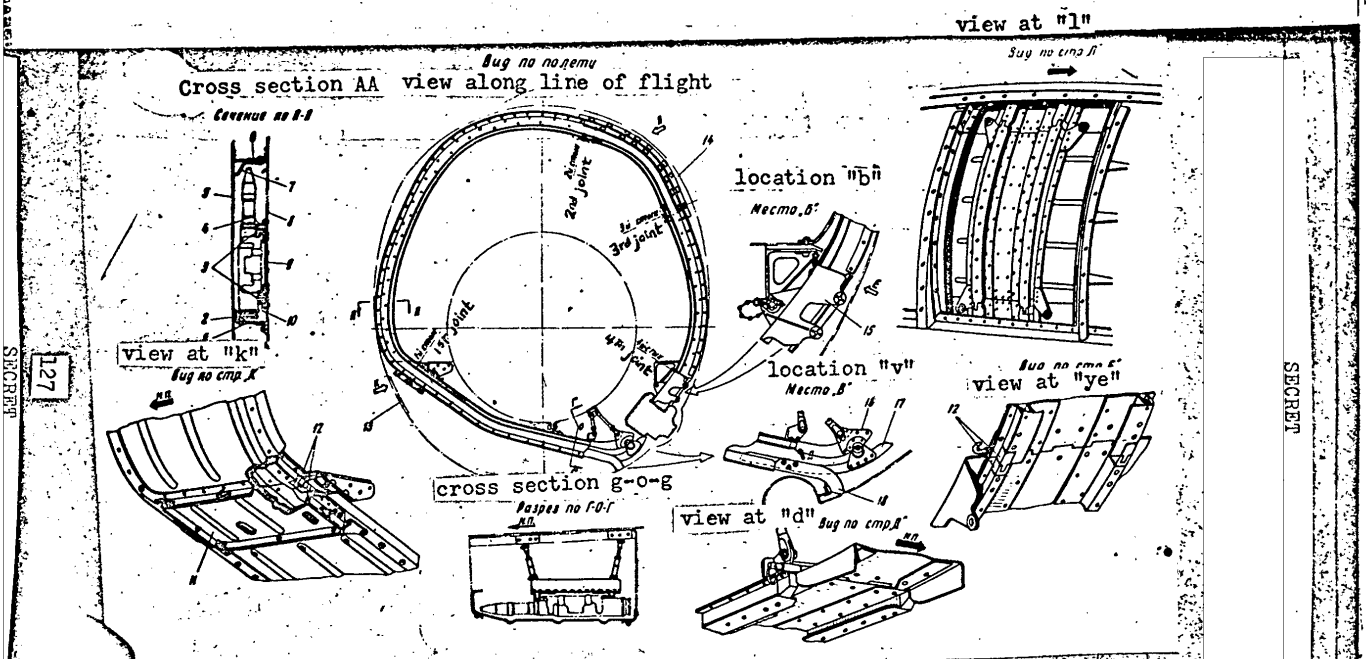

Figure 29. Feed Track

Фиг. 29. Тракт питания.

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Figure 29. The Feed Track [p 135]

1. Diaphragm
2. Angle bracket
3. Plate
4. Front profile
5. Fuselage skin
6. Diaphragm
7. Partition
8. Detachable part of tank bracket
9. Belt
10. Rear profile
11. Track hatch
12. Bushing
13. Hatch in fuselage
14. Fuel tank hatch
15. Feed chute
16. Upper link guide
17. Lower link guide
18. Servicing chute

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The second and third joints are located on the upper part of the right side of the fuselage. Access to these joints is provided through the hatch of the fuselage tank. [p 136

The fourth joint is located at the point where the cartridge belt guides are connected to the feed chute.

All the joints are made of special steel inserts.

In exploitation, the joints in the operating portion of the feed track should be examined for the absence of raised edges both in the direction of movement of the cartridge belt and against the direction of movement. The presence of such projections on the feed track is checked in both directions by hand and by the passage of an empty link over the joint.

These raised edges may be removed by filing the insert on the operating surface or by accurately shimming the guide profiles. The first, second, and third joints are inspected while conducting periodic maintenance work.

The condition of the fourth joint should be checked before each cartridge belt is serviced.

Dismounting the Lower Portion of the Guide Profiles of the Feed Track

To dismount the lower portion of the guide profiles it is necessary to:

1. Open the speed brake.
2. Remove the fairing and the hatch cover.

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3. Remove the upper and lower link guides. [p 137]

4. Remove the cannon.

5. Open the external access hatch to the first joint of the guide profile which is located on the left side of the fuselage.

6. Remove the hatch cover in the service tray under the fuselage hatch cover.

7. Unscrew the four screws which join the angle bracket, riveted to the guide profile, to the anchor nuts mounted on the fuselage beam.

8. Unscrew the four bolts which join the profile, mounted on the guide tray, to the four anchor nuts of the fuselage.

9. Disconnect the rods which reinforce the end of this guide.

10. Remove the lower part of the guide profile of the feed track from the right side.

Remounting the lower portion of the guide profile of the feed track is accomplished in the reverse order.

Dismounting the Remaining Parts of the Feed Track

The remaining parts of the guide profiles of the feed track are riveted to corresponding detachable portions of the tank container; to remove them it is necessary to unscrew the bolts from the anchor nuts located on the permanent parts of the container.

To remove the guide profile located between the third and fourth [p 138] joints it is necessary to unscrew two screws and bolts connecting the profile to the electrical bracket.

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These guides may be removed through the tank hatch.

The guide profiles located between the first and second and between the third and fourth joints are removed by removing the fuel tank.

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CHAPTER III [p 139]

THE TECHNICAL MAINTENANCE OF UNGUIDED ROCKETS

1. General Information on the Rocket Armament System

Two UB-16-57U pods containing 16 rockets (S-5M or S-5K) may be attached to the BDZ-60-21U wing pylons with DZ-57 locks in place of the K-13 homing missiles.

The rocket pods are discharged during firing with the aid of a PUS-36D fire control mechanism.

Firing of the rockets is interlocked with the position of the nose landing gear.

The presence of suspended pods is indicated by the signal lights "RS, APU Attached."

The aircraft is equipped for emergency jettisoning and blocking of emergency jettisoning of the loaded pods.

Universal Weapon Pod UB-16-57U

This universal weapon pod is used for firing S-5M or S-5K aviation rockets. The weight of the pod without rockets is 54 kg, and with S-5M rockets -- 117 kg.

There are 16 openings in the forward fairing through which the [p 140] rockets are launched.

The rear fairing is attached to the body with the aid of lugs and is prevented from turning by a stop device which enters a socket of a bracket of the housing (Figure 30).

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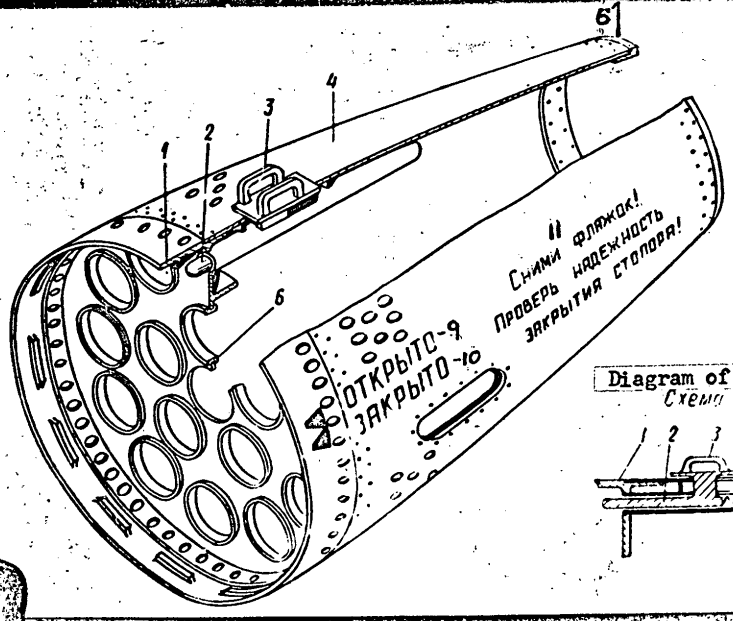
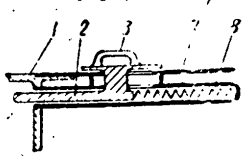


Diagram of stop device

Схема стопора



Фиг. 30. Задний обтекатель блока УБ-16-57У.

1-обод; 2-стопор; 3-башмак; 4-обшивка; 5-кольцо; 6-вкладыш; 7-корпус стопора; 8-пружина.

Figure 30. Rear Fairing of UB-16-57U Pod
1. Rim; 2. Stop device; 3. Shoe; 4. Skin;
5. Ring; 6. Insert; 7. Holder of stop device;
8. Spring; 9. "Open;" 10. "Closed;" 11. "Remove

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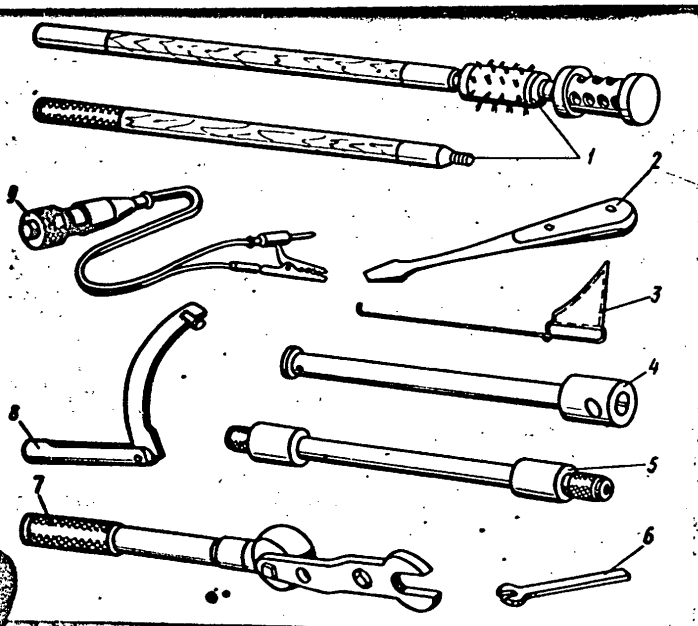

Фиг. 31. Инструмент и принадлежности блока УБ-16-57У
1-развертка; 2-отвертка; 3-ключ стопора обтекателя; 4-толкатель; 5-переходник
7-ключ тарировочный; 6-ключ; 8-ключ обтекателя; 9-контрольная лампа.

Figure 31. Tools and Attachments for the UB-16-57U Pod
1. Reamer; 2. Screw driver; 3. Key for fairing stop device;
4. Plunger; 5. TKhP [boresight] adapter; 6. Wrench;
7. Torque wrench; 8. Fairing key; 9. Test light

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To facilitate attachment, the side walls of the fairing have two openings lined with a reinforcing shell and openings in the rim of the fairing for a key.

In order to determine whether the rear fairing is open or closed, red marks and the signs "Open" and "Closed" are painted on its casing and the skin of the pod.

Matching the two marks bearing the "Open" sign indicates that the rear fairing is ready for removal. This position is also required when mounting the fairing to the housing of the pod.

The pod is attached to the wing pylon with the aid of two yokes placed in the carrying arms of the DZ-57 lock. The yokes are adjusted in the vertical direction with the aid of a torque wrench (Figure 31).

Special holders are used to retain the rockets in the barrels. In the inside forward part of the body of the holder is a groove under a circular lug of the rocket plug and a spring which forces the plug out of the groove upon firing.

A key which fits in the groove of the barrel limits the turning of the holder in the barrel. The holder is prevented from moving backward by the clamp bushings on the fairing. [p 143]

In the rocket holder used with the UB-16-57U pod is a device for catching the plug after firing.

The electrical system of the pod is connected to the aircraft circuit by means of a plug connector which connects to a female plug in the wing pylon. Receptacles are located on the end of the pod housing for

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the purpose of receiving the plugs from the peripheral rockets. The wires of the five inside rockets are connected to the circuit through a socket.

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Wing Pylon BDZ-60-21U

[p 144]

Wing pylon BDZ-60-21U (Figs. 32 and 33) is a streamlined type truss designed to carry various types of military loads.

Attachment of the pylon to the wing is accomplished with the aid of 2 conical pins.

Openings in the form of ovals are located on the rear pin in order to allow for adjusting the pin on spindle X during the installation of the pylon on the aircraft.

Access to the pin nuts is achieved through the small openings on the upper surface of the wing.

In order to attach rocket pods or launching devices to the pylon, the DZ-57 lock is used, which is attached to the frame of the pylon with the aid of bolts with self-locking nuts.

In addition, there are 2 pairs of supports which are included in the pylon accessories which are used for restraining the launching mechanisms or rocket pods from longitudinal and transverse movement and for controlling them in firing.

Supports with a 60 mm forward and a 52 mm rear base are used for attaching APU-13.

A second pair of supports with a 120 mm forward and a 108 mm rear base are used for suspending the UB16-57U pods.

The forward support permits the launching devices and rocket pods to be controlled in a vertical plane within the limits of ± 30'.

Adjustment is made by turning a key inserted into the slots of the

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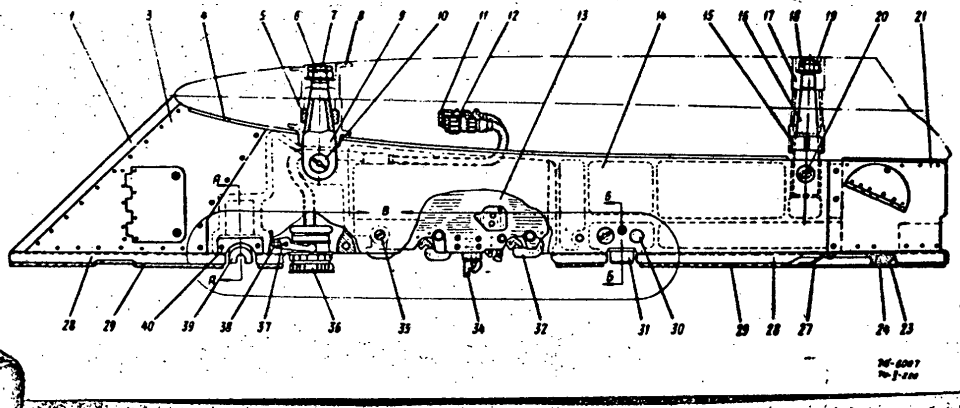

Фиг. 32. Подкрыльный балочный держатель БД3-60-21У.

Fig. 32. Underwing Pylon BDZ-60-21U

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Fig. 32. Underwing Pylon BDZ-60-21U [p 146]

1. knifelike front section; 3. forward fairing; 4. rubber gasket; 5. release bushing ring; 6. nut; 7. lock nut; 8. forward wing joint; 9. tapered bolt of the forward wing mounting; 10. pin; 11. plug connector ShR55MK30NG1; 12. plug connector ShR32MK10NG1; 13. lock DZ-57; 14. pylon frame (girder); 15. release bushing ring; 16. tapered bolt of rear wing mounting; 17. rear wing joint; 18. nut; 19. lock nut; 20. pin; 21. rear fairing; 23. peg; 24. telescoping assembly; 27. leaf spring; 28. adapter beam (stationary portion); 29. adapter beam (with springs on bottom; 30. adjustment pin for rear support; 31. rear support; 32. DZ-57 lock carrying arms; 34. load suspension locking and signalling rod; 35. lock attachment pin; 36. plug connector 2RM42KPN30G2V1; 37. lever; 38. spring; 39. forward support; 40. access to adjustable bushing of forward support.

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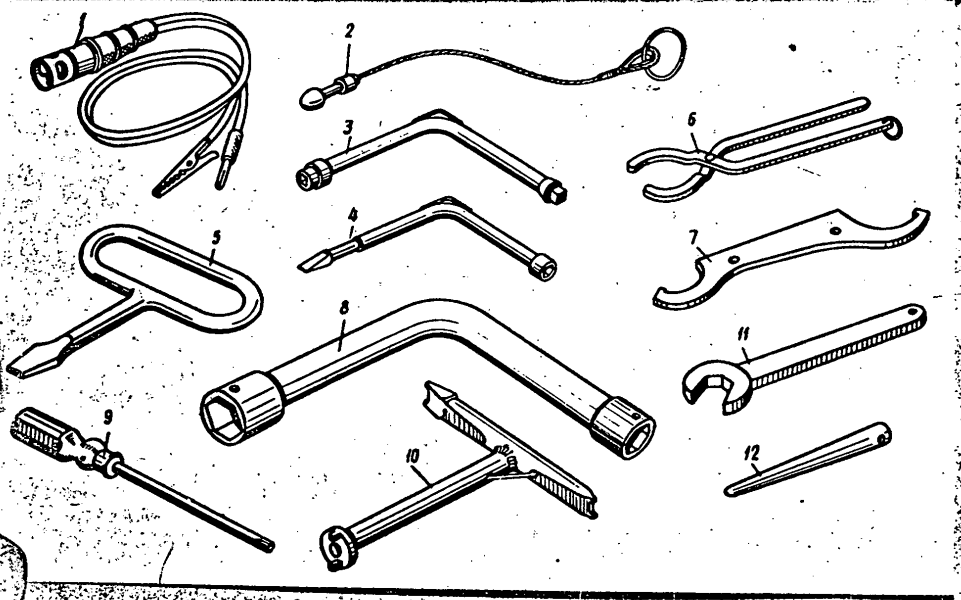

Фиг. 33. Общий вид инструмента и принадлежностей держателя БДЗ-60-21У
1-контрольная лампа; 2- контрольный шарик; 3- ключ для задного узла упора и стыковки ШР; 4-ключ для переходной балки; 5- отвертка усиленная; 6- клещи для ШР; 7- ключ переднего упора; 8- ключ для переднего и заднего шкворней; 9- отвертка; 10- ключ для замка и упоров; 11- ключ для контрольных гаек; 12- шпилька.

Fig. 33. General view of the tools and accessories of the pylon BDZ-60-21U
1- pilot light; 2- check ball; 3- wrench for the aft support assembly and connection of the ShR; 4- intermediate beam wrench; 5- reinforced screw driver; 6- pliers for ShR; 7- wrench for the forward support; 8- wrench for forward and aft main pins; 9- screw driver; 10- wrench for the lock and the supports; 11- open end wrench; 12- peg.

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support bushing. Access to the slots is closed with a cover on two anchor nuts.

The rear support controls the launch mechanisms and rocket pods in a horizontal plane within a limit of ± 25'. [p 148

The body of the support is secured to the pylon frame by two bolts, the forward one of which has a smooth surface and serves as a guide. The second bolt is threaded, and turning it with a wrench moves the support horizontally.

The main bolt of the back support is held in the pylon with a pin which is held in place by a spring.

An intermediate beam is attached to eliminate the gap between the pylon and the launch mechanism or rocket pod when they are suspended on the lower surface of the pylon.

The electrical equipment of the pylon consists of a ShR32PK10NG1 (plug), a ShR55PK30NG1 (plug), a miniature connector 2RM-42KPN30G2V1 (socket), and wire bundles.

The pressure of the spring on the lever, the arm of which enters a slot of the miniature connector, ensures the security of the connection of the miniature connector to the launch mechanism or pod. The connector is disconnected by turning the axis of this lever.

The plugs of the plug-and-socket connectors of the pylon are connected to the aircraft circuit through holes in the wing located between the pylon fastening points.

There are corresponding openings for the cocking, mechanical release, and control of the cocked position of the DZ-57 lock on the sides

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of the pylon body. Near the opening on the right side is an arrow and [p 149] the inscription "Cock," indicating in which direction the wrench should be turned when cocking the lock, and near the opening on the left side is an arrow and the inscription "Release," indicating the direction for mechanical release of the lock.

The DZ-57 Lock

The DZ-57 lock with electromagnetic release mechanism is used to suspend the rockets.

Basic operating data

1.	Operating voltage	27 v ± 10%
2.	Minimum operating voltage	20 v
3.	Current consumption at 24 v and temperature of + 20° C	
	-for tactical operation	6.3 a
	-for emergency operation	6.9 a
4.	Operating temperature range	- 60° to + 60° C
5.	Weight of lock	4 kg

The closed position of the carrying arms of the lock (Fig. 34) is ensured by the simultaneous catching of:

a) the small stop lever of the lock with the cocking lever;

b) the stop lever with the aft carrying lever;

v) an intermediate arm with a catch in the anchoring sector of the [p 152] electromagnet. The size of the catch in the anchoring sector must be

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within 2.2 to 2.5 mm.

The other shoulder of the anchoring sector of the electromagnet is for the mechanical release of the catch.

For resetting the lock it is necessary to turn the supporting arms in the direction of flight and, holding them in this position, turn the cocking recess axis with the key (Fig. 35) in the direction of the arrow until the intermediate arm engages with the catch in the sector of the electromagnetic mechanism. It is also necessary to hear the typical click sound.

The MBSVN-57 blocking and signalling mechanism installed in the catch of the system for the control of the rocket is used to signal the presence on the wing pylon of the launch mechanism or the rocket pod and for blocking the electrical circuit for emergency jettison.

The rod on the MBSVN-57 is pushed in when suspended and both the contacts for signalling and the upper contacts for blocking are closed. This switches on the circuit for emergency jettisoning.

In its initial position the rod closes the blocking contacts which are in the automatic lock release circuit during the accidental release of the load on the other pylon.

In the electrical circuit of the aircraft, the catch is connected with a 10-pin plug ShR32PKIONGI.

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Fig. 34. Lock DZ-57. "Closed" Position

Фиг. 34. Замок ДЗ-57. Положение "закрыто".

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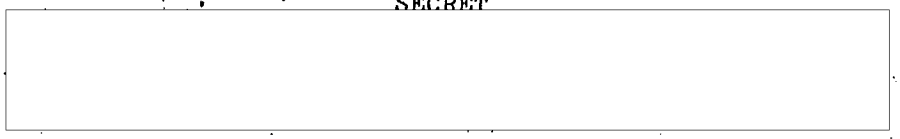

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Fig. 34. Lock DZ-57., "Closed" Position [p 151]

1. plug and socket; 2. front push-pull rod; 3. drum; 4. trigger spring; 5. trigger spring rod; 6. cocking axis; 7. cocking lever; 8. small stop lever; 9. vibration absorber; 10. connecting link; 11. stop lever; 12. vibration absorber; 13. back push-pull rod; 14. body; 15. back carrying arm; 16. electromagnet of trigger mechanism; 17. trigger lever; 18. intermediate lever; 19. adjustment screw of armature shifting angle of electromagnetic release mechanism; 20. trigger lever retracting spring; 22. cap of locking and signalling mechanism rod; 24. body with fixed contacts of the blocking and signalling mechanism; 25. middle carrying arm; 26. vibration absorber; 27. stop; 28. stop spring; 29. front carrying arm; 30. ring of suspended load.

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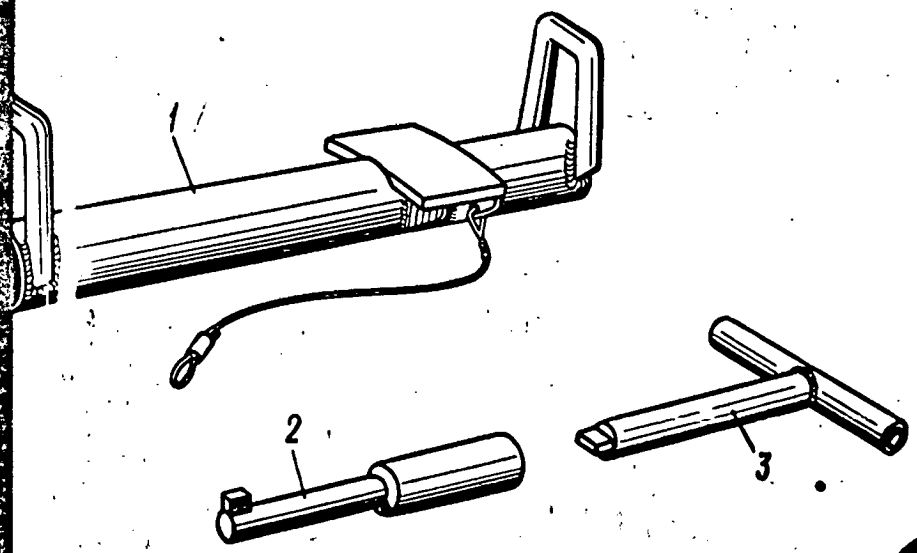

Фиг. 35. Общий вид инструмента и принадлежностей замка ДЗ-57.

1-приспособление для проверки замка; 2-ключ ручного спуска; 3-для взвода.

Fig. 35 General view of instrument and attachments for lock DZ-57 1. attachment for checking lock; 2. key for manual launch; 3. cocking key

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PUS-36D Fire Control Mechanism (Fig. 36, 37, 38) [p 154]

The PUS-36D fire control mechanism is designed for producing a series of 36 pulses of electric current and distributing them through the proper circuits in a given order.

Basic Technical Data

1.	Operating voltage	27 v ± 10%
2.	Current consumed	1.6 a
3.	Time interval between pulses (normal conditions)	25 msec ± 10%
4.	Pulse duration	7 ÷ 15 msec
5.	Maximum number of pulses	36
6.	Operating conditions:	
	a) series of 36 pulses;	
	b) series of four pulses;	
	c) series of two pulses.	
7.	Operating temperature range	-60° ÷ +60°
8.	Hold-down time of firing button to guarantee that all 36 pulses will work	not less than one second

Warning: In order to avoid burning of the winding of the mechanism, the button should not be held down for more than 15 seconds.

In the initial position brush #1 is on the first lamel of the outside row of the distributor and brush #2 is in the gap between the lamels in the inside row. Contact K1 shuts off with contacts K2 and K3. Contact K4 shuts off upon contact with the ratchet wheel. In addition,

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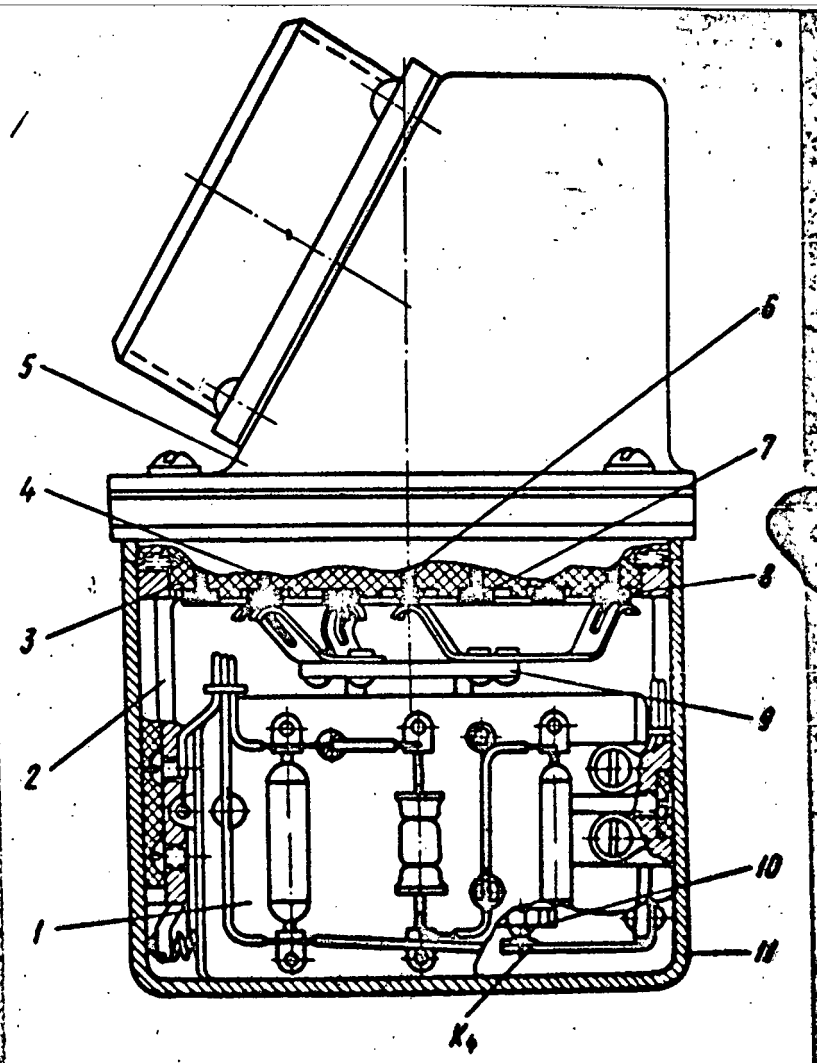

Фиг. 36. Общий вид прибора управления [illegible]

1- электромагнитное реле; 2- основание; 3- распределитель; 4- ламели внутреннего ряда; 5- корпус с штепсельным разъемом; 6- контактная заклепка; 7- контактное кольцо; 8- ламели наружного ряда; 9- подвижный контакт с щетками; 10- храповое колесо; 11- крышка; К4- контакт в цепи сигнальной лампы прибора в нулевом (исходном) положении.

1. electromagnetic relay; 2. base; 3. distributer; 4. lamels of inside row; 5. housing with plug connector; 6. contact rivet; 7. contact ring; 8. lamels of outside row; 9. sliding contact with brushes; 10. ratchet wheel contact; 11. cover; K4. contact in signal light circuit of instrument's null (initial) position.

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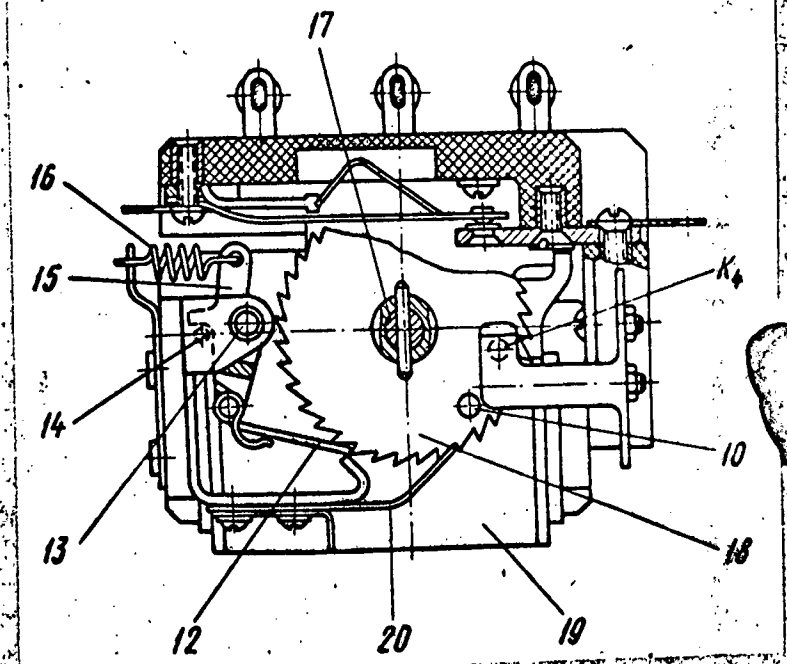

Фиг. 37. Электромагнитное реле ПУС (вид сбоку)
(нумерация позиций одинак с
фиг. 36 и 38)

10- контакт храпового колеса; 12- собачка; 13- ось качалки; 14- поводок; 15- качалка; 16- пружина; 17- вал храпового колеса; 18- храповое колесо; 19- катушка электромагнита; 20- пружина.

Fig. 37. Electromagnetic Relay PUS (side view)
(position numbers identical to figures 16 and 18)

10. contact of ratchet wheel; 12. catch; 13. rocker axle; 14. link; 15. rocker; 16. spring; 17. spindle of ratchet wheel; 18. ratchet wheel; 19. electromagnetic coil; 20. spring.

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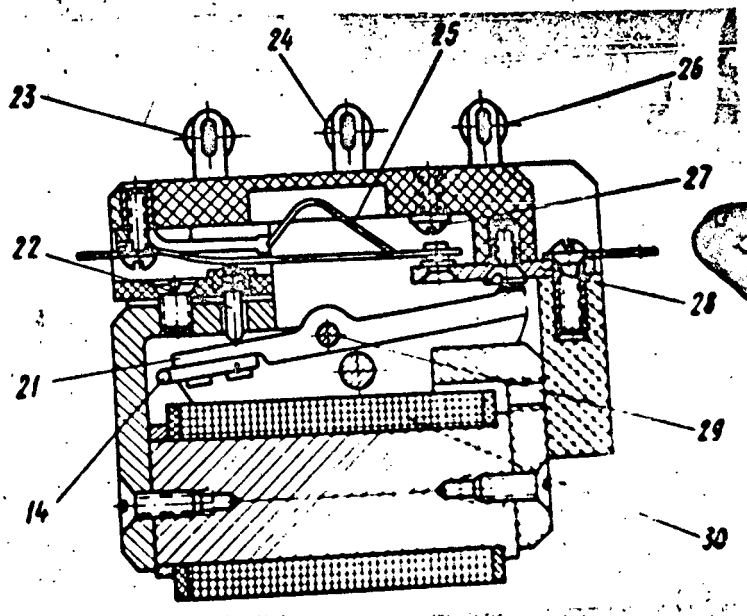

Fig. 38. Cross-Section View of Electromagnetic Relay (position numbers identical to figures 36 and 37)

Фиг. 38. Электромагнитное реле в разрезе

(нумерация позиций одинаковая с фиг. 36 и 37)

14- [illegible]; 21- якорь; 22- толкатель; 23- конденсатор; 24- германиевый диод; 25- [illegible] или пружина; 26- сопротивление; 27- [illegible]; 28- плата с контактами (К2, К3); 29- [illegible]; 30- обмотка реле.

14. link; 21. anchor; 22. push rod; 23. capacitor; 24. germanium diode; 25. three-leaf contact spring; 26. resistor; 27. support; 28. plate with contacts (K2, K3); 29. anchor axis; 30. relay coil.

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the light signalling the initial position of PUS-36D must be on.

For two-pulse series operation, the switch is set on the "I Salvo" position. The current from circuit breaker "RS" enters all of the lamels of the inside row of the distributor and the relay winding (Fig. 39). [p 158]

This connection provides for a two-pulse series distribution to the outside row lamels of the distributor and thence to the appropriate circuit for each depression of the firing button.

After emitting the second pulse, the armature remains engaged while the firing button is depressed.

Upon releasing the firing button, the current supply to the relay winding stops, the armature, under the action of the spring, returns to the initial position, brush #1 is fixed on three lamels of the outside row, brush #2 is between the lamels of the inside row, and contacts K1, K2 and K1, K3 are closed.

All 36 current pulses are released upon the 18th successive depression of the button. The ratchet wheel makes a complete turn, its contact moves to contact K4, and at the release of the button, closes with it.

In addition, the light signal comes on indicating the initial position of the device.

For four-pulse series operation the switch is set in position "2Salvo."

Upon pushing the button, a positive current flows to the even lamels of the inside row. The mechanism produces four pulses and stops. After 10 successive depressions of the button the mechanism produces 36 pulses and returns to the initial position.

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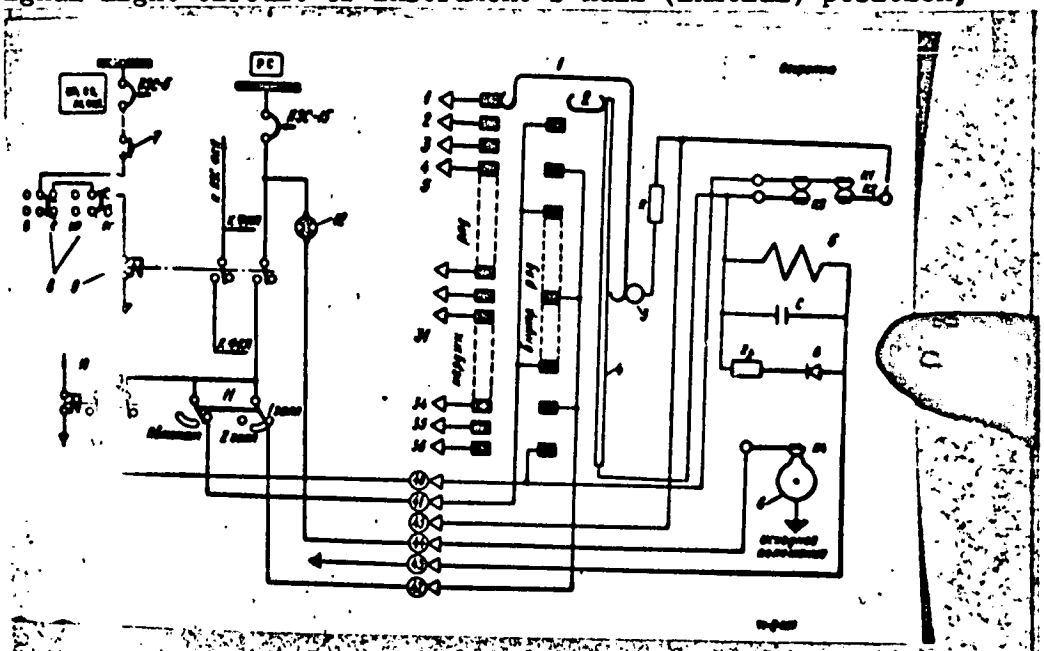
1. brush No 1 (sends pulses to lamels of outside row of distributer); 2. brush No 2; 3. contact rivet; 4. contact ring; 5. relay coil; 6. ratchet wheel; K1, K2, K3 - contact group contacts; K4 - contact in signal light circuit of instrument's null (initial) position;



Фиг. 39. Принципиальная электросхема ПУС-36Д.

I- щетка № I (передает импульсы на ламели внешнего ряда распределителя); 2- щетка № 2; 3- заклепка контактная; 4- кольцо контактное; 5- обмотка реле; 6- храповое колесо; K1, K2, K3 - контакты контактной группы; K4- контакт в цепи сигнальной лампы нулевого (исходного) положения прибора; R - регулируемое сопротивление; R_2 - сопротивление 2 ом; C - конденсатор; 7- германиевый диод; 7- кнопка отрельбы; 8- переключатель отрельбы и рода оружия; 9- реле пуска РС и включения СНП; 10- реле блокировки пуска [illegible] по массе; 11- переключатель залпов РЗ; 12- лампа сигнализации исходного положения ПУС-36Д.

R - control resistor; R_2 - 2 ohm resistor; C - capacitor; B - germanium diode; 7. firing button; 8. firing and armament type selector switches; 9. rocket launching and FKP switch-on relay; 10. missile and rocket launching and L. G. blocking relay; 11. rocket salvo selector switch; 12. PUS-36D initial position signal light. -

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For a 36-pulse series operation, the switch is placed in the "Automatic" [p160] position.

On pushing the button, PUS-36D sends out 36 pulses and stops upon reaching the brush on the last lamel of the inside row, since current from circuit breaker "RS" is fed through the contacts of the firing relay to this lamel.

After releasing the button the mechanism returns to its initial position.

Connections in the aircraft are made so that there is only one pulse from each pair from the PUS-36D mechanism to the terminal circuit (for any position of the firing mode switch), and the time between firings increases correspondingly to 50 msec.

During ground testing of the mechanism it is necessary to wait for a period of not less than 1.5 minutes after each three complete operations.

Schematic Diagram of Rocket Control (Fig. 40)

The rocket control circuit provides for:

1. Firing of rockets from the rocket pods
   a) singly from each pod;
   b) in a series of two rockets;
   v) in a series of single rockets until the fire unit is spent.
2. Signalling the null (initial) position of the firing control mechanism. [p163]
3. Signalling the attachment of rocket pods on the pylons.
4. Emergency jettison of pods from pylons by pushing emergency jettison button.
5. Blocking emergency jettison in event of accidental separation of pod from the other pylon.

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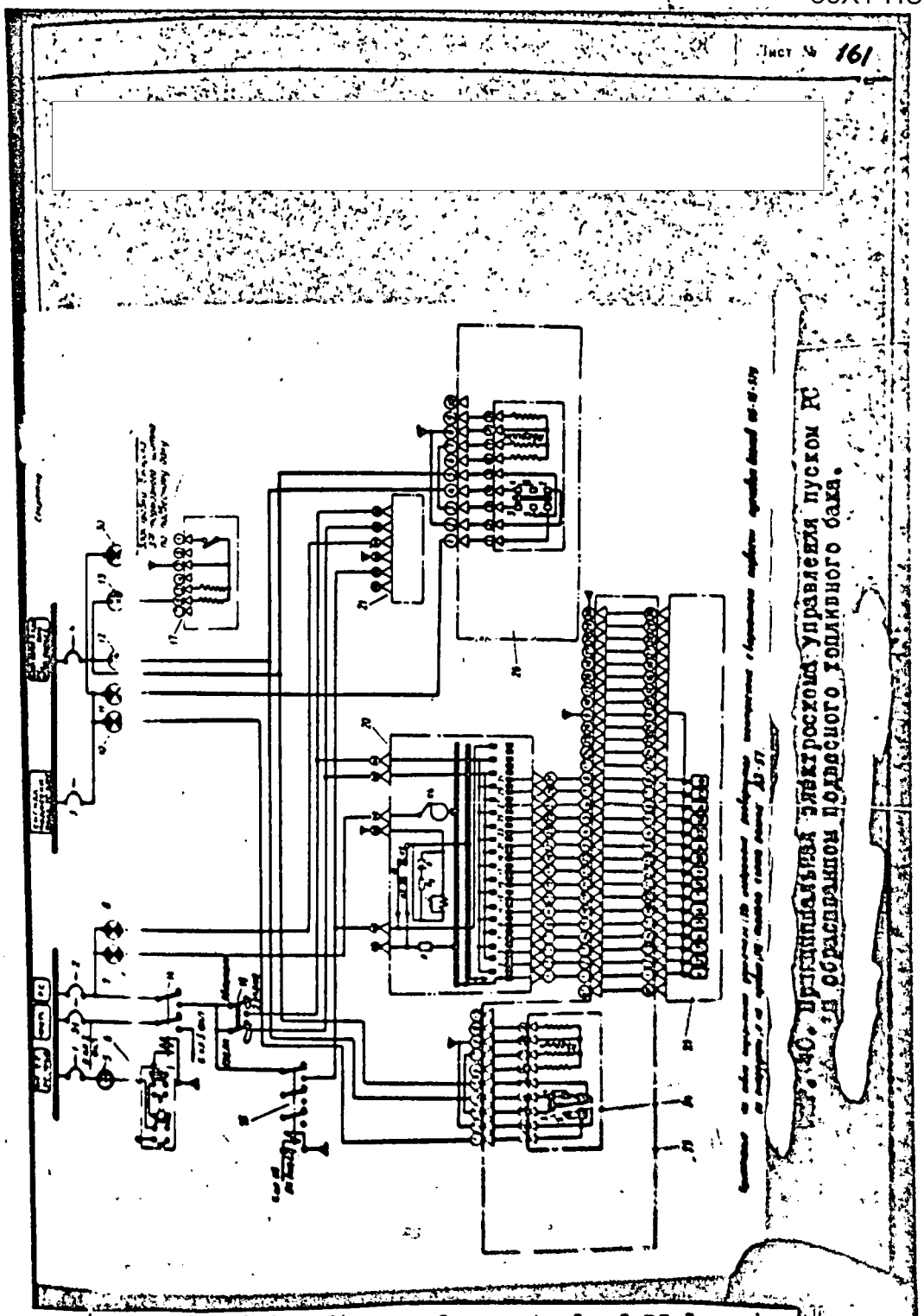

Fig. 40. Main wiring diagram for control of RS launch and jettisoning of belly tank.

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Fig. 40. Schematic Wiring Diagram of [p 162]
Control of Rocket Launch and Jettisoning of Fuel Tank

1. main AZS (circuit breaker) for armament installations control (17P); 2. AZS for rocket launch circuit (14B); 3. AZS for light circuits signalling presence of load on pylon (1B); 4. AZS for emergency jettison of pylon loads and emergency launch of K-13 missiles (9B); 5. firing button (18P); 6. sight switch panel (16P); 7. ready (initial position) signal light for left PUS (13B); 8. ready (initial position) signal light for right PUS (12B); 10. light signalling presence of load on left pylon lock (24B); 11. light signalling presence of load on right pylon lock (25B); 12. button for emergency jettison of load (23B); 13. button for jettison of drop tank (10B); 14. circuit relay for rocket launch and FKP [gun camera] (41P); 17. lock BDZ-56-Ye for attachment of drop tank (5B); 18. relay for interlocking rocket and missile launch with landing gear position (20B); 19. rocket salvo switch (15B); 20. control instrument PUS-36D in left wing (16B); 21. control instrument PUS-36D in right wing (17B); 23. left pylon BDZ-60-21U; 24. attachment lock DZ-57 in left pylon (40B); 25. pod UB-16-57U; 26. right pylon BDZ-60-21U; 30. light for signalling attachment of drop tank (7B); 31. AZS for FPK [gun camera] circuit (19P).

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6. Blocking firing when nose landing gear is down.

Part/of the rocket control circuit indludes elements of the K-13 system control circuit. These elements are:

1. Signal light indicating attachment of launching mechanisms or rocket pods on DZ-57 locks.

2. The circuit breaker "Signal for suspension of pod, RS, APU."

This system is used only to feed voltage to the lights to signal the attachment of the pod on lock BDZ56Ye and the rocket pods or the launch mechanisms on locks DZ-57. The lights signaling "Suspension of RS, APU" and "Suspension of drop tank" are located on the middle panel in the lower part of the instrument panel.

3. Lock DZ-57 with electromagnetic launch mechanism and the blocking and signaling mechanism MBSVN-57.

4. The circuit breaker "Emergency jettison of tank, RS, APU. Emergency launch of SS" and the button "Emergency jettison of RS, APU-SS." Emergency jettison of the launch mechanism or of the rocket pod, with or without rockets, is accomplished by pressing this button.

5. Relay to block fire during extension of nose landing gear. [p 164]

This relay is for prevention of accidental firing on the ground. In the retracted position of the landing gear, the relay winding is under voltage. The current to the blocking relay enters through the end switch from the circuit breaker "Landing Gear Signal ANO."

Current to the winding of this relay may also be applied by pressing the light monitoring button on panel NPS-2, which is premitted only for checking the working order of the firing circuit.

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In addition to the elements of the circuit which provide for signaling attachment and emergency jettison, the following are also installed in the system for control of the rocket:

1. Two PUS-36D fire control mechanisms, one for each pod. Access to the mechanisms is through the upper access hatch of the wing, located between the pylon mounts.

2. The circuit breaker "RS" is installed on the right front panel. Current flows through this circuit breaker to the relay contact and to the lights signaling the null position of PUS-36D.

3. Alternate firing switch for the rocket pods. The switch is located on the left side of the cockpit and may be set at one of the following positions: "Salvo 1," "Salvo 2," or "Automatic."

4. Lights to signal the null positions of PUS-36D. The lights serve for monitoring the status of the fire control mechanisms; these must be in the initial position before reloading the pod.

When PUS-36D is in the initial position the lights go on. With the [p 165
first depression of the firing button the lights go out. The lights go on again after the PUS-36D has sent all 36 pulses and after release of the button returns it to the initial position.

5. Electrical wiring of the rocket pod to the contact jacks for ignition cable plugs. The numbers on the pod chambers indicate the order of discharge when firing (Fig. 41).

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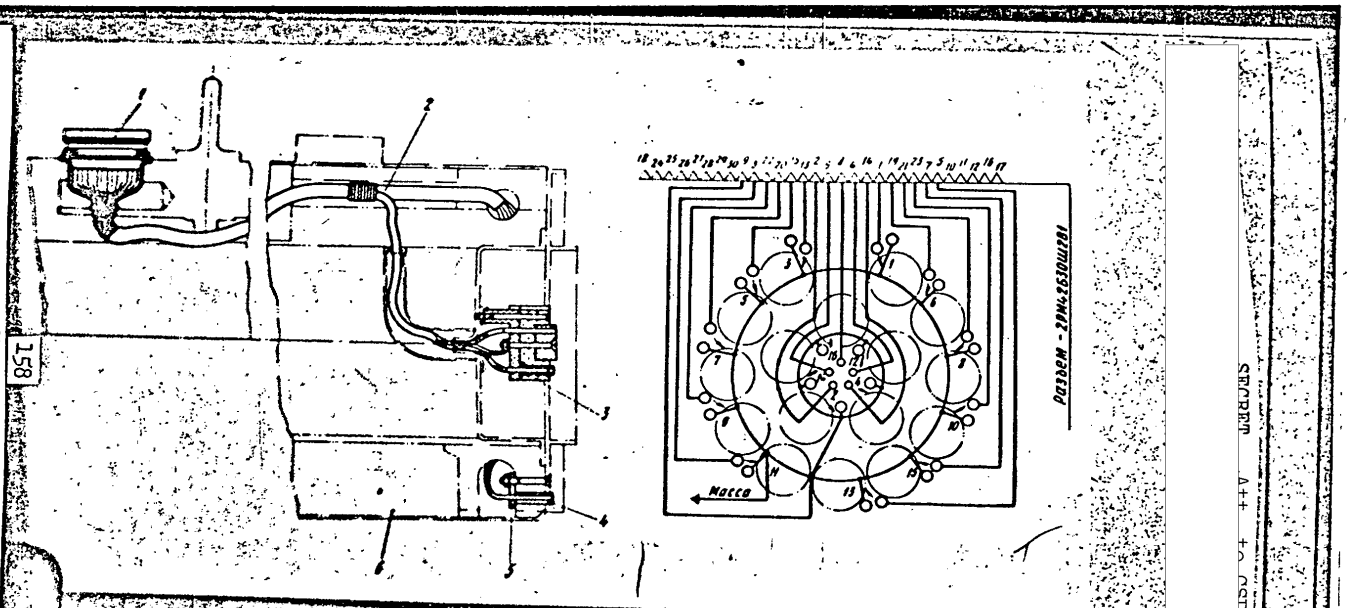

Фиг. 41. Принципиальная схема электропроводки в блоке и принципиальная электросхема распределения импульсов тока к снарядам.

1-вилка разъема; 2-электропроводка; 3-розетка; 4-гнездо; 5-щиток; 6-блок.

Fig. 41. Electrical wiring diagram for pod and schematic electrical diagram of the distribution of current pulses to rockets.

1. connector plug; 2. electrical wiring; 3. socket; 4. jack; 5. brush; 6. pod

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2. Checking the Working Order of the Fire Control Circuit

The working condition of the rocket fire control circuits is checked before each use.

The check is made in the following order:

1. Close the levers of the lock, making sure that they are closed tightly, attach the pod stirrups to the carrying arms of the locks, tighten them with a torsion wrench, and connect the plugs of the pods to the pylon plugs.

Switch on the battery and the circuit breakers "RS," "NR, SS, RS, FKP;" "Signal of attachment of tank, RS, APU," and the "Signal for landing gear ANO;" ascertain the working condition of the signal light "Suspension of RS. APU," which should be on.

3. Set the switch "S-B" on the sight bracket in position "S", and switch "NR-30-RS" to position "RS".

4. Set the firing mode switch to the "Automatic" position. [p 167]

5. Push the button on the PUS-2 panel and the fire control button. After 1-2 seconds both buttons should be released and the signal lights should show that the PUS-36D fire control mechanism is in the null position. In this position the lights "Null position RS" should go on.

6. Set the firing mode switch to the position "Salvo 1."

7. Remove the rear fairing and connect the pins of the control panel to the contact jacks.

8. Push the light monitoring button on panel PUS-2 and hold it in that position during the test.

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9. Push and then release the firing button and, by the lighting up of the control light on the panel, check the current sent to the contact jack of the first rocket. At the same time, ascertain that the null position lights of PUS-36D are out.

10. In the same order, check the voltage to the contact jacks of the ignition cables of all the remaining pod chambers.

11. Set the PUS-36D to null position and check the current output to the contact jacks of the ignition cables when the switch is on "Salvo 2" and "Automatic."

12. Take the control panel pins out of the contact jacks and replace the rear fairing.

13. The same order is used in checking the working condition of the fire control circuit of the second pod. [p 168]

14. Set the PUS-36D in the initial position and switch off the circuit breakers and the battery.

3. Checking the Emergency Jettison Circuit of the Rocket Pods

A check of the working condition of the emergency jettison circuits is made for each new suspension of the rocket pods on the wing pylons.

The check is conducted in the following manner:

1. Inspect in detail the condition of the visible parts of the levers of the DZ-57 lock; ascertain the reliability of their locking and the effectiveness of the mechanical release.

2. Switch on the battery, the circuit breaker "Emergency jettison of tank, RS, APU. Emergency launch of SS."

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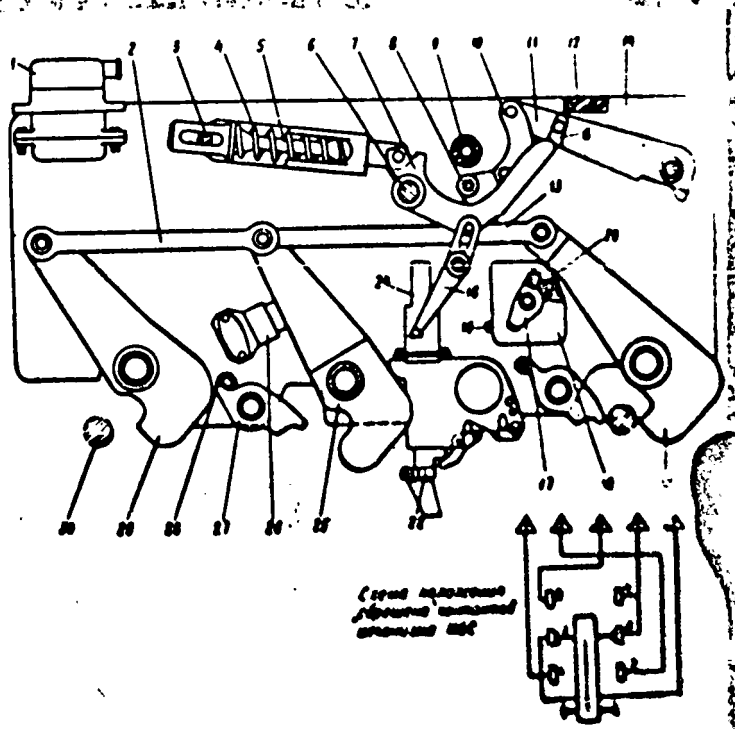

Fig. 42. Lock DZ-57, "Released" Position (positions are the same as in figure 34)

Фиг. 42. Замок ДЗ-57, Положение "Открыто" (позиции те же, что и на фиг. 34)

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3. Close the lock and attach the lock inserts to the carrying arm for test release.

4. Push the button "Emergency jettison of RS, APU-SS." Ascertain that the carrying arms of the lock open and the inserted pieces suspended thereon are dropped.

5. Perform a test jettison of the rocket pod. When jettisoning pods it is necessary to hold them up by hand.

The plug connector of the wing pylon is not connected to the pod connector and the launch mechanism connector during controlled release.

6. Switch off the circuit breakers and the battery. [p 170]

7. Check the working order of the blocking circuit in the following manner:

a) close the wing pylon locks;

b) switch on the circuit breaker for emergency jettison and battery;

v) push in the rod MBSVN-57 on one of the pylons and ascertain that the lock of this pylon is opened without pressing the jettison button. Release the rod of the mechanism.

g) perform a similar check on the other pylon.

For simultaneous service by several specialists, it is more expedient to check the emergency jettison blocking circuits in the following order:

a) close the wing pylon locks;

b) switch on the emergency jettison circuit breaker and battery;

v) push in rod MBS on both locks simultaneously;

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g) release rod MBS on the lock of the right wing pylon and ascertain that the carrier arms of the lock for the left pylon are open;

d) push in the rod again and then release the rod of the lock installed in the left pylon and ascertain that the lock of the right pylon is open.

If a subsequent test is necessary, it is expedient to change the sequence of the operation of the locks.

Warning: Never attach a load to only one of the pylons, since, when the battery is switched on (breaker for emergency jettison is on), the suspended pod UB-16-57U or the launch mechanism APU-13 will be dropped. [p 171]

4. Attachment of the Rocket Pods

The rocket pods are attached to the wing pylon locks in the following order:

1. Examine the wing pylon and the DZ-57 lock.

2. Check the functioning of the lock using the emergency jettison button. Ascertain the condition of the blocking circuit for emergency jettison.

3. Remove from the pylons the supports which are used to hold the APU-13 launch mechanism.

4. Install the supports with the 120 mm forward base and 108 mm rear base on the pylons.

5. Close the DZ-57 lock and make sure it is locked.

6. Prepare the pod for suspension. Suspension of loaded pods is forbidden.

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7. Remove the protective cap from the plug connector of the pylon and, with the aid of a wrench, raise the connector and plug it into the place vacated by the pin through the opening in the body of the pylon.

8. Turn the lugs of the suspension yokes 10-15 mm, insert the yokes into the openings of the carrying arms of the lock, and, with the key, tighten the pod to the pylon until the electrical connector "2RM" is flush. [p 172]

9. Connect the plug connector of the wing pylon to the female connector of the pod as follows:

a) remove the stop pin from the pylon opening and, holding the connector with the square end of the key, lower it down evenly until it joins with the connector of the launch mechanism;

b) direct the socket with special pliers inserted through the opening in the transverse beam so that the pin on the housing of the female part of the plug connector for the pod fits into the notch of the socket housing;

v) finish tightening the socket of the wing pylon until there is complete connection with the plug connector of the pod by turning the lever shaft with the key.

10. Making sure that the insertion of the support components of the pod into the corresponding support of the wing pylons is correct, tighten the pod to the pylon with the torsion wrench.

11. Check the working condition of the control circuits on the control panel and the sighting according to TKhP. Sight adjustment is made during the first pod attachment.

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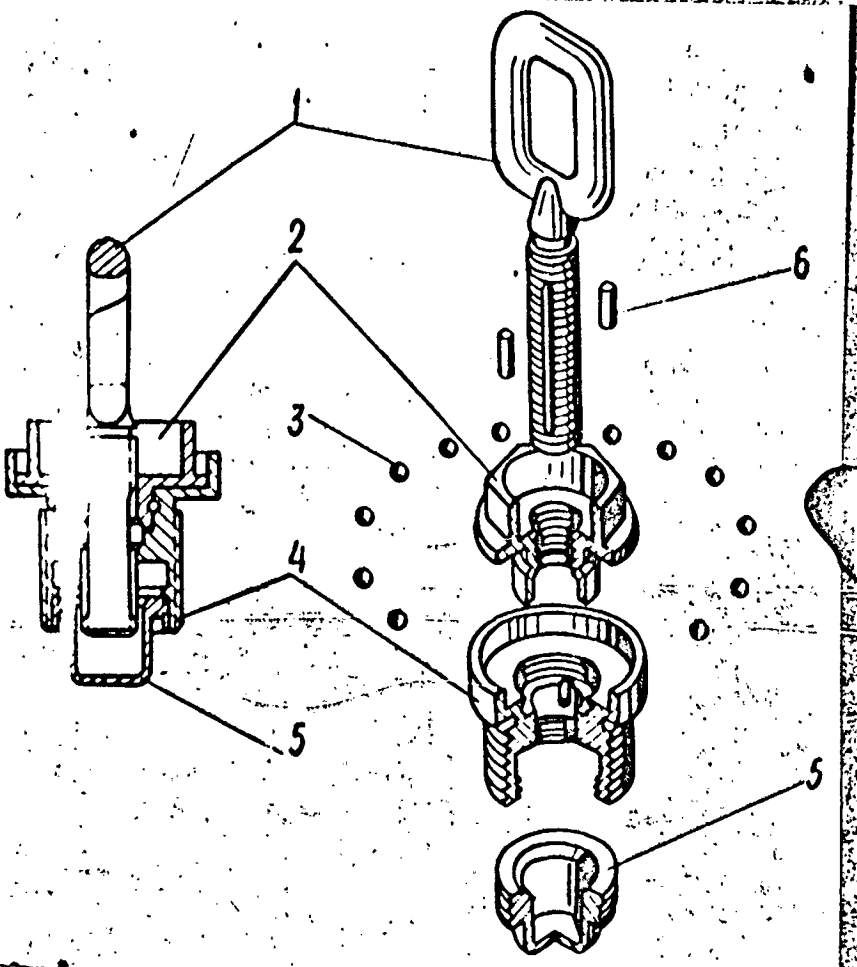

Рис. 43. Узел подвески.

1-болт; 2-втулка; 3-шарик; 4-стакан; 5-гайка; 6-палец.

Fig. 43. Suspension assembly
1-bolt; 2-bushing; 3-ball bearing; 4-cup; 5-nut; 6-pin.

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5. Loading the Rocket Pods [p 174]

The rocket pods are loaded after an external examination of the condition of the suspension system, checking the fire control system, and completing the preparation of the other types of armament. When loading it is necessary to:

1. Remove the rear fairing of the pod as follows:

a) take the stopper completely out of the jack clamp with the aid of the special key with the flag and fasten the key to the stopper opening behind the pod fairing;

b) insert a second key into the aperture of the rim of the fairing, turn the fairing until the "Open" marks coincide, and detach the fairing from the pod.

2. Remove the rocket holders from the barrels of the pod.

3. Wipe off any grease and dirt from the barrels and holders.

4. Connect the ground power source to the plane, switch on the circuit breakers located in the fire control circuit, and, from the control panel, check the voltage output to the socket jacks of the pod.

After checking, the battery and circuit breakers in the fire control circuit should be switched off.

5. Examine and check the readiness of the rockets and igniters for loading.

For this it is necessary to:

a) remove the casing from the rocket half way down the stabilizer fins and clean the paper and grease from the centering bulges of

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the rocket;

б) remove the casing and check the stabilizer fins for proper [p 175] opening;

Warning: It is necessary to remember that the stabilizer fins will open sharply under the action of the springs. Therefore, the casing should be removed carefully by holding the bottom part with arms extended to prevent injury.

Fold back the fins of the stabilizer after checking and slip the rocket into the casing;

в) unscrew the plug from the hole and then screw in the fuse and tighten it securely with the key.

Readying the rockets and arming them with fuses must be done beforehand in a place set aside specially for this.

6. Remove the casing again and push the rocket into the barrel so that the fins are partly inside the barrel and then remove the casing.

7. Break the filament which connects the contact wire of the rocket to the rocket and unwind the wire. Examine the wire and the plug, check for damage, and then pass the plug through the hole in the catch and lead the wire through the slot of the key of the rocket holder.

8. Attach the holder (fig. 44) to the rocket so that the annular lug of the plug on the rocket opposes the spring of the holder and enters the groove for it.

9. Move the rocket into the barrel up to the support on the collar of the holder at the end of the barrel. It is then necessary to see that the wire from the rocket and the key on the holder enter the special

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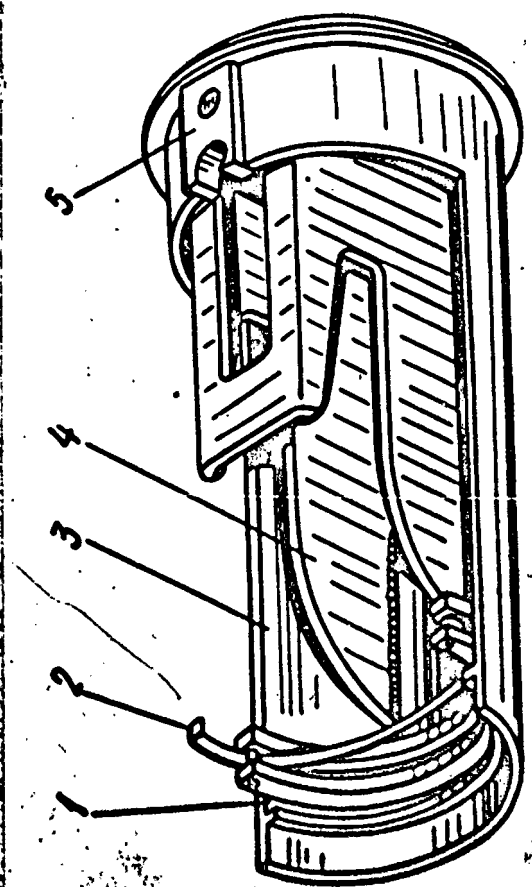

Fig. 44. Rocket holder

1-groove under circular lug of plastic collar of the rocket; 2-spring; 3-housing of holder; 4-catch; 5-key.

Фиг. 44. Держатель снаряда.

1-паз под кольцевой выступ пластмассовой втулки снаряда; 2-пружина; 3-корпус держателя; 4-защелка; 5-шпонка.

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recess in the barrel.

10. Insert the plug for the fuse of the rocket into the corresponding jacks on the housing of the pod. [p 177]

All barrels of the pod are loaded in this manner.

Warning: After loading it is necessary to carefully straighten the plug wires between the ends of the barrels to prevent cutting the wires during installation of the rear fairing of the pod.

11. Attach the rear fairing of the pod as follows:

a) insert the lugs of the rim into the spaces between the corresponding lugs of the clamps of the pod. The line marked "Open" on the fairing must coincide with the mark on the housing of the pod;

b) with the key which has been inserted into the aperture on the rim of the fairing, turn the latter until the "Closed" mark coincides with the mark on the housing of the pod;

v) remove the key from the shoe and make sure that the stopper goes completely into the jack of the housing mount.

Turn the fairing to make sure that it is secure.

6. Unloading the Rocket Pods

Upon cancellation of a flight or upon return of the aircraft with unexpended rockets in the pod, the pod should be unloaded in the following order:

1. Make sure that the battery switch and the circuit breakers located in the fire control circuit are turned off.

2. Remove the rear fairing from the pod. [p 178]

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3. Remove the ignition cable plugs of the rockets from the contact jacks of the pod.

4. Pull the rocket holder 60 to 80 mm out of the barrel so that the stabilizer fins do not show.

5. Pull the cable plug of the rocket out through the opening of the catch and separate the holder from the rocket.

6. Slip the casing over the exposed part of the rocket fins.

7. Pull the rocket completely out of the barrel, pushing the casing over the rocket at the same time.

8. Unscrew the fuse, screw in the plug in its place, examine the wire, and place the rocket into a packing box.

All barrels are unloaded in the same order. Unloading may be started from any barrel.

9. Clean and lubricate the barrels, place the holders into the barrels, and replace the rear fairing.

It is necessary to compress the spring of the holder with one's finger until the holder is inside the housing (when installing the holders without rockets.)

7. Removal of Rocket Pods

Where the rocket pods are not used for a long period of time, they should be detached from the wing pylons and the DZ-57 locks should be opened.

The pods which have been removed from the aircraft should be kept

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in a dry storage area on shelves or in packages greased with a protective coating.

For lengthy storage (more than three months) the pods must be packed. [p 179]

In removing the pod it is necessary to:

1. Ascertain that the pod is empty.

2. Disconnect the holder plug from the pod plug as follows:

a) insert the key in the lever axis aperture and, by turning it in the direction of the arrow "Disconnect," disconnect the plug socket of the wing pylon from the terminal connector of the pod;

b) through the opening in the wing pylon, place the pin under the lever, keeping the plug socket of the pylon in the removed position.

3. Holding the pod by hand, open the levers of the DZ-57 lock with the key and detach it from the pylon.

Warning: It is forbidden to remove a loaded pod.

The circuits for emergency jettison control should be turned off when removing and when attaching pods; otherwise, when the battery is switched on and after one lock has been opened, the lock may trip and the suspended pod on the other lock will fall to the ground.

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CHAPTER IV

TECHNICAL SERVICING OF THE K-13 HOMING MISSILE SYSTEM

1. GENERAL INFORMATION ON THE SYSTEM

The system consists of:

1. The K-13 homing missile with a homing thermal head capable of day and night operation.
2. A device for the support and launching of missiles.
3. The range-only radar "SRD-5MK" with the VRD-2A computer.
4. The ASP-5ND sight with infrared viewer SIV-52.
5. Aggregates for power supply, launching, and control.
6. Control-checking apparatus and ground equipment.

1. Homing Missile K-13 (Fig. 45)

The K-13 homing missile of the "air-to-air" class is intended for hitting an airborne target day or night under ordinary meteorological conditions at all altitudes at which a fighter plane flies, and in the entire range of speeds, beginning with 0.8 meters.

The missile is built in accordance with the "Utka" aerodynamic plan, with an X-type arrangement of the rudders and wings. It has a symmetrical streamlined metallic body, cylindrical in form and with a hemispherical nose section.

[182] To facilitate interchangeability and for convenience of assembly and disassembly, the main parts of the missile are structurally designed in four separate, adjoining sections.

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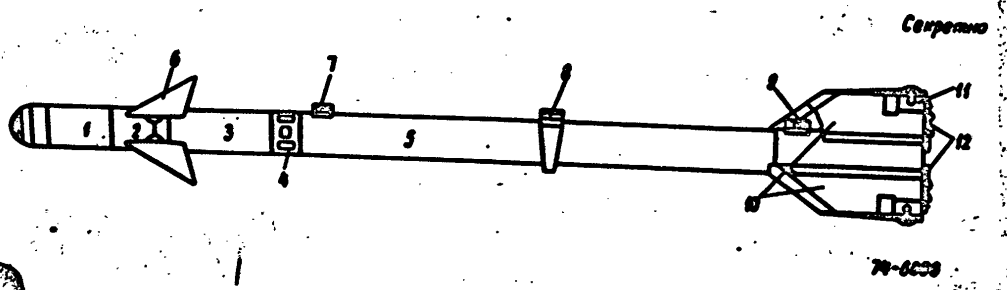

Фиг.45. Блочная схема ракеты.

1- Головка самонаведения; 2- отсек рулевого механизма; 3- боевая часть; 4- неконтактный взрыватель; 5- пороховой ракетный двигатель; 6- рули; 7- передняя направляющая; 8- средняя направляющая; 9- задняя направляющая; 10- кили; 11- стабилизаторы; 12- стопорные пальцы.

Fig. 45. Block diagram of the missile
1-homing head; 2-stearing mechanism section; 3-war head; 4-proximity fuse; 5-solid fuel hot-air missile motor; 6-vanes; 7-forward guiding attachment; 8-middle guiding attachment; 9-rear guiding attachment; 10-fins; 11-stabilizers; 12-stopper pins.

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The first section consists of two parts, which include the homing thermal head and the steering mechanism.

The homing thermal head is an optical-gyroscopic instrument which operates by a passive method based on the thermal radiation of the target. It is designed for locking-on and tracking a target at any time of the day or night, outside of cloud areas, and at an angle of not less than 20° to the sun.

The thermal radiation from the target is intercepted by the optical system of the head; it is then transformed into control signals which are sent through a magnetic amplifier unit to the windings of electromagnets in the steering mechanism located in the second part of the section.

Target lock-on by the head takes place while the missile is still in the launching mechanism of the aircraft. A sound signal in the form of a modulated audio frequency voltage is transmitted to the headset of the pilot, indicating that the target has been locked on.

The second part of the section contains the steering mechanism, the solid-propellant gas generator with a distributing ring, a turbogenerator and thermoregulator, and a safety-actuating mechanism of contact operation.

The steering rudders are activated by the steering mechanism and are [183] located on two perpendicular planes set at an angle of 45° to the horizon and mounted on the body of the section.

A shear-type electric plug 6R-20 which connects with a plug of the launching device is located between the steering rudders.

The second section is the warhead of the missile. The body of the section is a structural part of the warhead and provides directed fragments during explosion.

The third section contains the proximity fuse which includes an

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electronic optical unit, the battery supplying electrical energy, and the safety-activating mechanism.

The optical proximity fuse serves the purpose of exploding the warhead of the missile during its flight near the target or for self-destruction of the missile in case of a miss.

The fourth section contains the solid reactant rocket engine which provides the missile with the speed which is necessary to intercept the target. This section is the main power source of the missile.

The forward suspension guide which contains the contacts of the circuit for igniting the detonator of the solid-fuel charge in the engine and the contact for the circuit which activates the thermal batteries of the proximity fuse are mounted on the housing of the forward part of the motor.

The center suspension guide is fastened by means of a collar on the [184] center part of the housing of the solid fuel rocket engine.

The rear suspension guide and the fins, which are located in the same planes as the missile's steering rudders, are mounted on the rear part of the housing of the solid-fuel rocket engine.

Gyroscope stabilizers for slip stabilization are mounted on the fins of the missile.

2. Mechanism for Missile Suspension and Launching

Suspension of the K-13 homing missile is carried out with the aid of the APU-13 aviation-type launching mechanism on the BDZ-21U wing pylons. For this purpose the pylons are reinforced with supports having a 60 mm base in front and a 52 mm base at the rear which hold the supports of the launching mechanism when it is suspended.

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The lugs of the launching mechanism are placed in the carrying arms of lock DZ-57. The force required to hold the launching mechanism on the wing pylons is 900-1200 kilograms.

In order to impart direction to the missile when launching, the APU-13 is provided with guides with transverse slots through which the missiles are passed during attachment to the launching mechanism.

An arresting device is installed in the launching mechanism in order to lock the missile and prevent possible longitudinal shifting caused by inertial forces. [185]

A roller is attached to the forward support of the arresting device and provides a stable sliding force equal to 350±35 kilograms during launching of the missile. This force may be adjusted by spring tension by rotating the flange square located on the upper surface of APU-13 under the safety plate. (Figure 46).

The rear support of the arresting device acts as a limiter of the guide of the missile. In order to prevent dropping of the support and backward movement of the missile, the arresting device is provided with double-shoulder lever which, with the two projections of one shoulder, rests on the projection of the antivibrator plates, while a bolt which rests on the housing of the arresting device is screwed into the other shoulder.

Lifting of the arresting device for the removal of the missile is carried out by means of a socket wrench placed on the square end of the axis of the lever [word obliterated]. The wrench is turned in a counterclockwise direction.

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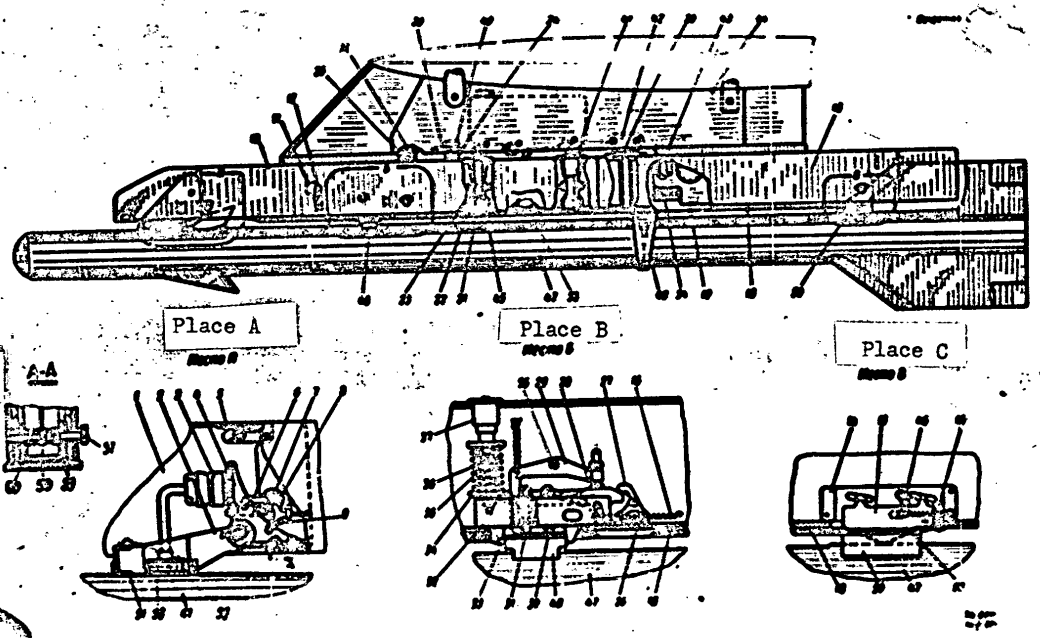

Стр. 46. Автономный пусковой устройство АПУ-13 и общая схема подвески ракеты.

Fig. 46. Aircraft-Type Launch Mechanism APU-13 and General Diagram of Missile Suspension

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Fig. 46. Aircraft-Type Launch Mechanism APU-13 [p 187]
and Overall Diagram of Missile Suspension

1. forward fairing; 2. bracket; shear-type plug; 3. plug connector ShRM-20; 4. bracket; 5. spring on axis of forward fairing bracket; 6. hook; 7. hook shaft; 8. bushing; 9. arresting device of hook rotation; 10. beam; 11. switch KV-9-T; 12. safety cotter pin with flag; 13. housing; 14. antivibrator plate; 15. antivibrator plate; 16. antivibrator spring; 17. contact spring; 18. guide; 19. electric launch mechanism EPU-13; 20. rear brace; 21. lock nut; 22. casing; 23. lug; 24. plug connector 2PM42B30Sh2V1; 25. forward brace; 26. plate; 27. lever; 28. latch shaft; 29. stop lever; 30. contact; 31. contact; 32. retaining latch; 33. roller; 34. base; 35. spring; 36. spring; 37. flange; 38. forward brace; 39. MR tightening lever; 40. pylon plug connector; 41. lock DZ-57; 42. pylon rear brace; 43. adapter beam; 44. pylon BDZ-60-21U; 45. connector nut; 46. lever; 47. missile K-13; 48. forward missile guide; 49. middle missile guide; 50. rear missile guide; 51. blade-like plate of bracket 2; 52. shear connector of missile; 53. negative bus; 54. connector N560-3 of electric launch mechanism; 55. lever axis; 56. spring; 57. rod; 58. screw; 59. bushing; 60. spring.

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The same lever is used to fasten the arresting device and completely lock it after suspension of the missile. In this case the axis of the lever is turned in a clockwise direction.

Two pairs of antivibrators are mounted on the launching mechanism to eliminate play between the guide of the launching mechanism and the missile guide.

To facilitate visual inspection of the reliability of fastening [188] of the catch, the beam of the launch mechanism has openings with plate covers. The check is made using control marks on the double-arm lever and the flanges of the forward antivibrator plates.

When the missile guide is completely fastened in the catch, the marks of the double-arm lever must not cross the marks made on the flanges of the forward antivibrator, toward the side of lesser overlapping.

Pressed in the housing of the catch are two insulation bushings in which two contacts are set. One of the contacts is included in the motor igniter circuit and the other, in the ignition circuit of the thermobattery of the optical proximity fuse.

In the rear part of the launch mechanism under the removable fairing is the electrical launch mechanism EPU-13.

Connection of electric power to EPU-13 from the aircraft circuit is made by joining the electric connector 2PM42B30Sh2V1 with the female connector of the wing pylon during suspension of APU-13.

Plug connector ShR-M20, which is connected to the cable of the shear-type plug connector SR-20 of the missile, is fastened to a bracket in the forward part of the launching mechanism under the hinged fairing.

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At this point a hinged bracket is fastened with springs; in the side [189] grooves of the bracket are plate-like latches which fasten the bracket to the shear plug after attachment of the rocket.

When the rocket moves along the guide, the protruding portion of the plug strikes the arresting plate of the bracket, cuts off, and withdraws behind the fairing of the launch mechanism.

The fixed position of the forward fairing is determined by the combination of the control marks etched on the fastener shafts and the fairing cover. Under the marks is an arrow with the sign "closed." The arrow indicates the direction of rotation of the shaft for opening the fairing.

To prevent accidental launching of rockets while on the ground, a safety cotter pin with a flag is inserted in a special opening of the launch mechanism housing to break the motor ignition circuit.

Before flight the safety cotter pin is removed.

3. Range-Only Radar SRD-5MK -- With VRD-2A

The range-only radar operates in two modes, the first of which is intended for operation with gun and unguided rocket armament, and the second of which is intended for operation with the K-13 system. [190]

The mode is established with the aid of switch "RS, Gun-SS," which is mounted on the vertical section of the left console of the cockpit.

In operation with the K-13 system, the range-only radar with VRD-2A ensures:

a) automatic and continuous computation of the present (true) range to the target and presentation of this value to the range indicator UD-1;

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b) automatic comparison of the present (true) range with permissible range for launching the K-13 missiles, and issuance of a permissible range signal to the signal light "Permissible Range;"

v) issuance of a signal of the necessity for withdrawal from attack to the signal light "Withdraw from Attack."

The range indicator with the signal lights "Permissible Range" and "Withdraw from Attack" are located on the left side of the ASP-5ND sight head.

Locking on the target by the range-only radar is signalled by lighting of the green light "Lock-on" on the left section of the sight head.

In the gun and unguided rocket armament mode, the range-only radar, from the moment of lock-on, continuously transmits voltages proportional to the range to the target to the computer part of the sight.

The range of stable lock-on of the radar for a fighter-aircraft target is: [191]

a) at least 1400 meters in the gun and unguided rocket mode;

b) at least 4500 meters in the K-13 mode.

The range-only radar is turned on by moving the switch from the position "OPT" to the position "Radio" on the bracket on the right side of the sight head. The signal light located next to this switch indicates the presence of high voltage in the range-only radar. The range-only radar receives its power through the circuit breaker "SRD."

4. Sight ASP-5ND With SIV-52

In working with the homing rocket mode, the ASP-5ND sight is used as an ordinary collimator viewer.

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Sighting is done by superimposing the central point of the sight grid on the target while the arrester handle of the sight head is in the position "Fixed." In doing this, the aircraft acquires the orientation necessary for the thermal heads of the homing rocket to "lock on" the target.

To conduct aimed firing at night, the aircraft is equipped with the infrared viewer SIV-52.

The SIV-52 is mounted, serviced, and checked in accordance with the instructions on it.

5. Aggregates of the Power, Launch Control, and Monitoring Circuits. (Figure 47) [192]

The circuits for power supply, control, and monitoring of the K-13 system include:

1. Electrical launching mechanism EPU-13, designed to supply power to the missile while suspended, determine the functioning of the missile and its readiness for launch and signal this information to the pilot, and provide for the necessary switching of electrical apparatus at the moment of launch.

2. Overload indicator MP-28A, installed in the recess behind the cockpit light to the left of the No 12 frame.

In the event of overloads exceeding 2 G at altitudes up to 14,500 meters and 1.6 G above 14,500 meters, the overload indicator emits a signal to the red light "Overload Signal." This light warns the pilot that under these conditions, missile launching is not permitted. The light is located adjacent to the "Withdraw From Attack" light.

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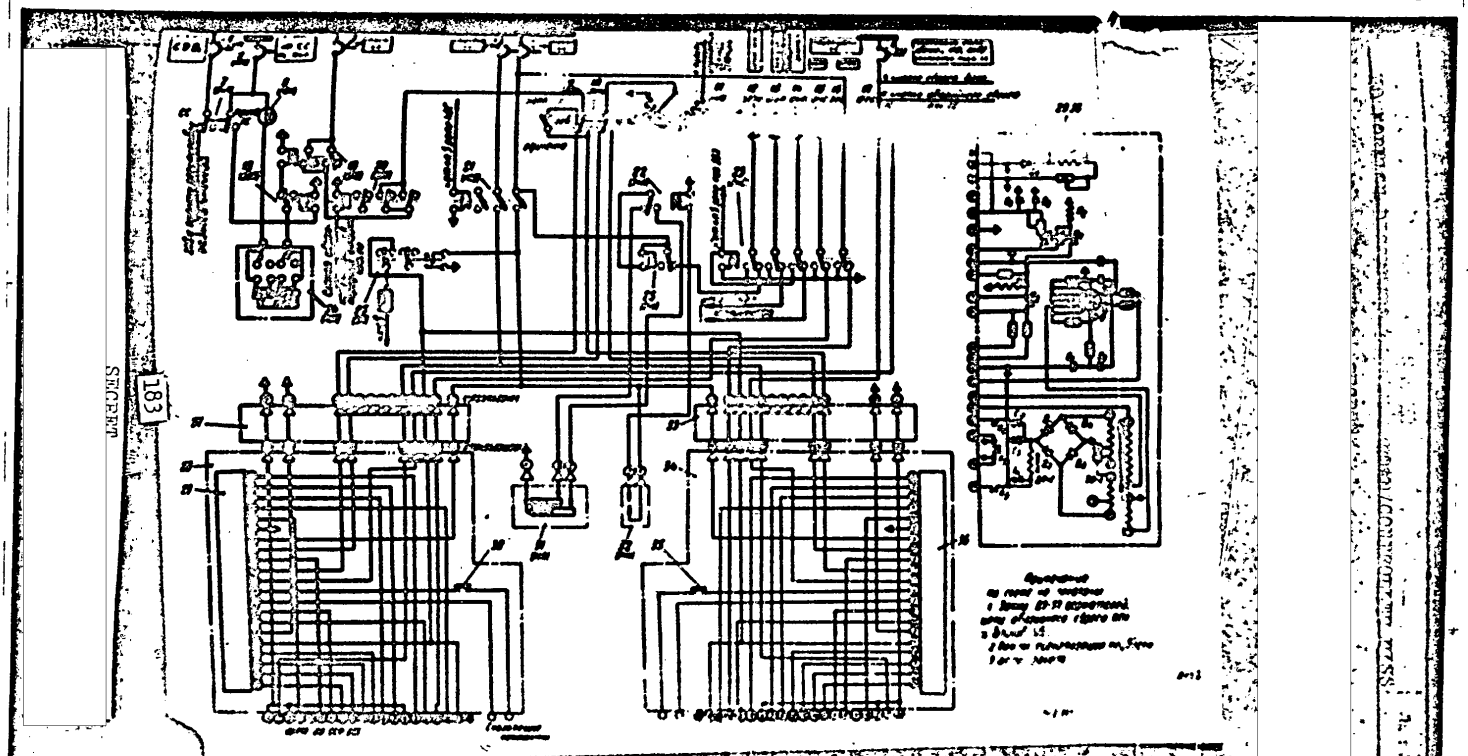

Fig. 47. Main wiring diagram for missile launch control.

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Fig. 47. Main Wiring Diagram of Missile Launch Control System [p 194]

1. circuit breaker for range-only radar switch; 2. master circuit breaker for switches in circuits for control of armament installations; 3. circuit breaker for missile launch circuits; 4. circuit breaker for missile warm-up; 5. circuit breaker for ignition of missile; 6. circuit breaker for circuits controlling emergency pylon jettison and emergency missile launch; 7. selector switch for mode of range-only radar and firing circuits; 8. fire button; 9. "Salvo-Single" switch for launching missiles; 10. switch for separate launching of missiles; 11. volume control for lock-on signal; 12. overload signal light; 13. withdraw from attack signal light; 14. permissable range signal light; 15-16. signal lights indicating presence of missiles on APU-13 launch mechanisms; 17. emergency launch button; 18. relay for switching from gun to SS launch circuits; 19. relay switch for missile (SS) launch circuits; 20. relay for locking SS and RS launch with position of landing gear; 21. disconnect relay for heavy loads (blocking); 22. relay for overload signal circuit switches; 23. relay for monitoring performance of signal lights; 24. switch panel for sight; 25. relay switch for PO-500A converter for power supply to missile; 26. overload signal relay switch; 27. left BDZ-60-21U pylon; 28. aircraft-type launch mechanism APU-13; 29. EPU-13 electric launch mechanism on left APU; 30. terminal switch in left APU; 31. overload indicator MP-28A; altitude indicator VS-14500; 33. right BDZ-60-21U pylon; 34. APU-13 on right pylon; 35. terminal switch in right APU; 36. EPU-13 electric launch mechanism on right APU.

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3. Altitude indicator VS-14500 sends an altitude signal to the relay when the overload factor on the MP-28A indicator shifts from 2 G to 1.6 G on reaching an altitude of 14,500 meters.

The altitude indicator is installed in the forward equipment hatch on the upper port side between frames 2 and 2 A.

4. On the right upper panel of the instrument board are installed:

a. Two switches marked "Launch SS" -- a switch marked "Left" -- "Right" which permit separate launching of the missiles and separate transmission of their audio signals.

The switch marked "Salvo" - "Single" determines the missile launch variation. For simultaneous launching of the missiles, the switch is set in position "Salvo". [195]

In this case the position of the "Left" - "Right" switches for launching has no significance and is used only for alternate listening to the missile sound signal.

b. The suspension signal lights "Suspended SS", "Left", "Right". The lights are colored green. They light up when missiles are present on the launch mechanisms.

The power supply for the missile suspension signal lights passes through the "Filament SS" circuit breaker.

5. The emergency jettisoning button "Emer. Jettison RS, APU, SS". The button is installed on the panel in the left upper portion of the instrument board and is used for emergency jettisoning of any suspension variation from the lock carrying arms of the wing pylons.

6. On the left panel of the cockpit are installed:

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a) Volume control for the sound signal entering the pilot's headset from the TGS of the missile with the notation "Lock-on Signal;"/

b) Operating mode selector switch for range-only radar with notation "RS, Gun-SS; "

7. The "Emer. Launch SS" button. This is installed in the upper right portion of the instrument board.

8. On the panel on the left side of the sight head are installed: [196]

a) Three signal lights: "Withdraw From Attack", "Overload Signal", and "Permissible Range;"

b) Range indicator "UD-I" with a 0-8 km scale, showing the present range value as determined by the range-only radar.

9. On the forward right electrical panel are the following circuit breakers: "Sight, Sight Warm-up", "Sight", "SIV-52", "Warm-up SS", "Filament SS", and "Launch SS".

(a) Through the "Warm-up SS" circuit breaker, voltage is fed from the aircraft's circuit to the thermoregulator and the heating elements for the solid propellant gas generator. On reaching the preassigned temperature, the thermoregulator contacts separate and heating of the PAD ceases.

(b) Through the "Filament SS" circuit breaker, voltage is fed to the overload signal light, the missile suspension signal lights, the altitude indicator light, the electric launch mechanism EPU-13, and through them to the filament circuits of the homing heads, and also through the relay for the PO-500A converter which is used to supply the K-13 system with 115 volts at 400 cycles.

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(v) Power is conducted to the launch circuit through the "Launch SS" circuit breaker. Power for launching is blocked when the forward landing gear is down.

10. On the rear electrical panel are the following circuit breakers: [197] "EMER. Jettison Tank, RS, APU", "EMER. Launch SS", and "NR, SS, RS, FKP".

11. Relay switch for fire control circuits NR-30 and SS, relay to block launch of SS and RS when nose landing gear is down, relay switch for launch circuits, relay switch for overload signal circuits, and others.

6. Combat Launch of Missiles

In each case, missile launching is conducted in accordance with the flight mission.

Before taking off with K-13 missiles, it is necessary to:

1. Set the operating mode selector switch of the range-only radar to the "SS" position.

WARNING: When the range-only radar selector switch is in the "RS, Gun" position, launch of K-13 missiles is impossible.

2. Set the "B-S" switch on the sight head bracket in the "S" position, and the "NR-30-RS" switch in the "NR-30" position.

3. Set the launch variation switch to one of the positions-"Single" or "Salvo" according to the flight mission.

For single launching, set the 2PP-45 launch switch in position "Left" or "Right", also depending on the mission.

In this case, the switch must be reset to the second position [198] following the first launch to prepare the second missile for launching.

4. Turn on the circuit breakers "Sight, Sight Warm-up", "Sight", "SRD", "AGD", "Warm-up SS", "Filament SS", "EMER. Jettison Tank, RS, APU. EMER. Launch SS", and "NR, SS, RS, FKP". [187]

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For safety, the "Launch SS" circuit breaker should be turned on in the air after take-off.

5. Set the arrester handle on the sight to the "Fixed" position. The "Base" handle, located on the left side of the sight head, is used to set the radius of the circle to 35 thousandths of the range. Adjust the brightness of the grid.

For night missions, turn on the "SIV-52" circuit breaker.

An aircraft, armed with missiles, is guided by the pilot along the pursuit curve by continuously superimposing the target over the central point of the sight grid.

The aircraft then assumes the orientation required for "locking on" the target by the thermal heads of the homing missile.

Target lock-on by the head takes place at the moment the range to target corresponding to the sensitivity threshold is reached. The pilot learns this by a change in tone and level of the sound signal.

Present range to the target is controlled by the pilot with the UD-1 indicator. [199]

As the aircraft approaches its target, at the maximum permissible distance the signal light "Permissible Range" lights up, signifying to the pilot that launching may be carried out.

Prohibition of launching due to overload is signaled by the "Overload Signal" light, which lights up when the overload exceeds 2G at altitudes below 14,500 and 1.6 G at flights greater than 14,500 meters.

When the present range reaches the minimum permissible range (1 kilometer), a red light marked "Withdraw from Attack" lights up, warning the pilot of the necessity to turn away from the target.

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Hence, missile launching is permitted when the sound signal reaching the pilot's headset signifies lock-on by the TGS of the missile, the "Permissible Range" light is burning, there are no overload restrictions, and the speed of the aircraft is not less than 0.8M.

The missile is launched by pressing the button on the control stick of the aircraft.

7. Emergency Jettisoning

Emergency jettisoning of the missiles from the launch mechanism is accomplished by applying a voltage to the DZ-57 electromagnetic locks installed on the wing pylons.

To apply this voltage, it is necessary to turn on the circuit [200] breakers marked "EMER. Jettison Tank, RS, APU, EMER. Launch SS", and press the button for emergency jettisoning "EMER. Jettison RS, APU, SS". The emergency jettison circuit breakers must be turned on before take-off.

8. Emergency Launching

In case of necessity, the missiles may be launched with the emergency launch button "EMER. Launch SS".

When the emergency launch button is pressed, voltage is fed to trigger the powder-propellant motor and to the electrical igniter of the thermo-battery for the optical proximity fuse independently of the state of readiness of the circuits for the missile and launching.

Voltage is applied in the same manner as for emergency jettisoning through the circuit breaker "EMER. Jettison Tank, RS, APU. EMER. Lanuch SS".

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2. SUSPENSION AND REMOVAL OF APU-13

Suspension of the APU-13 on the locks of the wing pylons is done by the same procedure used in the suspension of the rocket pods.

This procedure is outlined in the chapter on technical maintenance of unguided rocket armament.

The forward and rear supports used to suspend the rocket pods are [201] replaced by APU-13 supports having 52 and 60 millimeter bases, secured to the respective pylons.

Before each APU-13 suspension, the threaded parts of the stirrup brackets and the washers and bolts are lubricated with TsIATIM-201 grease.

The tightening of the stirrups of the launch mechanism is checked with a three-fold rotation of a torsion wrench. The wrench should be turned evenly without stopping.

After tightening with the torsion wrench, check the free passage of the TKhP-13 attachment along the entire length of the guide slot. For this it is necessary to raise the latches and guide the TKhP-13 attachment in the guide slot of the launch mechanism and move it along the slot so that the forward TKhP-13 guide is located near the forward antivibrator.

The bushing on the TKhP-13 should be facing forward in the direction of launch of the missile from the APU-13.

In the event that the attachment binds in the guide slot, the stirrup should be loosened and retightened with another wrench.

If the TKhP-13 attachment repeatedly binds in the guide of the launch mechanism, the stirrup tightening wrenches should be checked.

After suspension it is necessary to check the aiming accuracy, the [202] ease of movement of the rocket, and the working order of the power, launch, and monitoring circuits.

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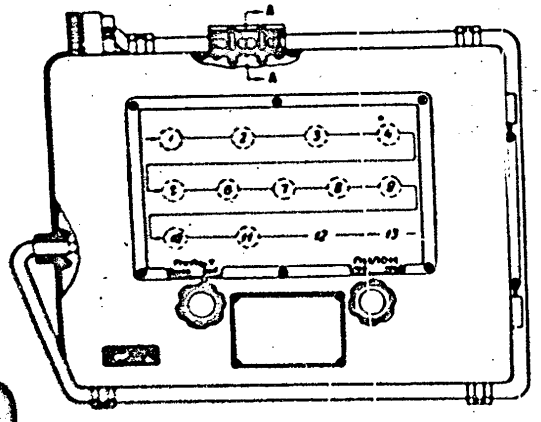

Фиг. 48. Верхняя панель пульта П-13А.
1-3. колодки; 4-прокладка; 5-крышка;
6-втулка; 7- шайба; 8-гайка; 9-контактный болт;
10- направляющая.

Fig. 48. Upper Panel of II-13A Console.
1. m-tip; 2. m;3.washers; 4. gasket; 5. cover plate; 6. bushing; 7. washer
8. nut; 9. contact bolt; 10. guide.

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In removing the launch mechanisms from the wign pylon, it is necessary to adhere to the following procedure:

a) be certain that the battery and the circuit breakers "Emergency Jettison Tank, RS, APU. Emergency Launch SS" are switched off;

b) place the wrench on the square end of the lever and, turning it in the direction of the arrow, unplug the wing pylon socket from its connection with the launch mechanism plug;

v) insert a pin under the lever through the opening on the wing pylon, stopping the plug connector in a retracted position;

g) keep the launch mechanism from falling and, with the help of the wrench, open the levers of the DZ-57 lock and separate the launch mechanism from the wing pylon.

3. CHECKING THE WORKING ORDER OF THE POWER, LAUNCH, AND CONTROL CIRCUITS WITH THE HELP OF SIMULATOR II-13A

The working order of the power, launch, and control circuits is checked with the help of simulator II-13A (Fig 48) before suspending the rockets on the launch mechanism. Do this as follows:

1. Connect ground electric power source to aircraft. [204]

2. Suspend the II-13A simulator on the launch mechanism which is being checked in such a way that the panel with the signal lights and range switch handles is toward the side opposite the fuselage. For this it is necessary to place the contact insert of the simulator into the forward slit (access) of the APU-13 guide and move the simulator forward along the groove of the guide up to the support, first raising the latch and the contact pins on the APU-13 with the special wrench.

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3. Attach the plug connector of the simulator cable to the ShR-M20 socket of the launch mechanism.

4. Switch on the battery and ascertain with the voltmeter that the voltage in the aircraft main circuit is 28.5±0.5 volts.

5. Set the launch variation switch "Left-Right" in the position corresponding to the launch mechanism being tested.

6. Switch on circuit breakers: "Warm-up SS," "Filament SS," "Launch SS,""Oil-Pressure Gage," and "Landing Gear ANO Signal."

7. Set one handle of the console in the position "Left" or "Right", and note whether the following six signal lights are lighted on the simulator panel:

"1" (L1) - "Warm-up," "M Signal" [205]

"2" (L2) - "Filament I"

"3" (L3) - "Filament II"

"4" (L4) - "Plate supply I"

"5" (L5) - Plate supply II"

"6" (L6) - "MKU I" and "MKU II"

Simultaneously with the lighting of these lights, there must be an audio signal in the headset and the light signalling suspension of the rocket must light up in the cockpit.

The audio signal is heard in the headset for both positions of the switch, on "Salvo" and on "Single". A change in the intensity of the audio signal is checked by turning the volume control knob.

8. Press the button on the PPS-2 panel and be certain that only the six above-mentioned lights continue to burn on the simulator panel.

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If other bulbs are lit before pushing the firing button, this is an indication that the launch mechanism is not in the proper working order.

9. Holding down the button of the PPS-2 panel, press the firing button and note that another five bulbs light up on the panel of the II-13A simulator:

"7" (L7) - locking device ("Locking device I" and "Locking device II")

"8" (L8) - "Bringing to zero"

"9" (L9) - "P/p PAD"

"10" (L10) - "p/p Engine"

"11" (L11) - "p/p AKK"

WARNING: It is forbidden to force operation of the simulator circuits with blows (light knocking) on the housing of the II-13A. [206]

10. While the firing buttons and the PPS-2 panel button are down, insert a safety cotter pin in the special opening of the launch mechanism and note whether light No 10 "p/p Engine" and 11 "p/p BAT" on the simulator go out.

11. Release the firing button and the panel button PPS-2 and switch off the circuit breakers.

WARNING: It is forbidden to check the launch circuits when the body of the contacts located in the housing of the APU-13 catch are short-circuited. This occurs in suspension of the K-13 missile pods, in mounting of the ZUS-13, etc. Such shorts can cause burning out of resistors in the EPU in the rocket launch circuit.

12. Check the working order of the emergency launch circuit:

a) remove the safety cotter pin from the opening of the launch mechanism;

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b) switch on the circuit breaker "Emergency Tank Jettison, RS, APU. Emergency SS launch;"

v) press the emergency launch button and be certain in doing [207] this that lights No 10 ("P/P Engine") and No 11 (p/p AKK) on the II-13A simulator go on. After checking, switch off the circuit breaker.

13. Set the simulator handle in the position "Off" and disconnect the plug connector from the ShR-M20 socket of the launch mechanism.

14. Switch off all circuit breakers and, raising the catch, move the simulator back until the contact plug meets the forward slit (access) of the APU-13 guide. Then remove the simulator from the launch mechanism.

15. The working order of the power, launch, and control circuits of the rocket suspension on the other wing pylon are checked by the same procedure.

If in checking the control circuits only part of the signal lights are lighted, this is an indication that the launch circuit is not in working order. The series number above the first unlighted signal light of the simulator will indicate the inoperative circuit.

If in checking, the first or one of the middle bulbs is unlighted and all the remaining bulbs are lighted, it is necessary to:

a) switch off the simulator and all circuit breakers;

b) remove the simulator from the launch mechanism being checked;

c) replace the unlighted bulb;

d) make a second check of the same launch assembly.

In order to replace the light it is necessary to remove the front [208] screen of the simulator, having first unscrewed the mounting screws.

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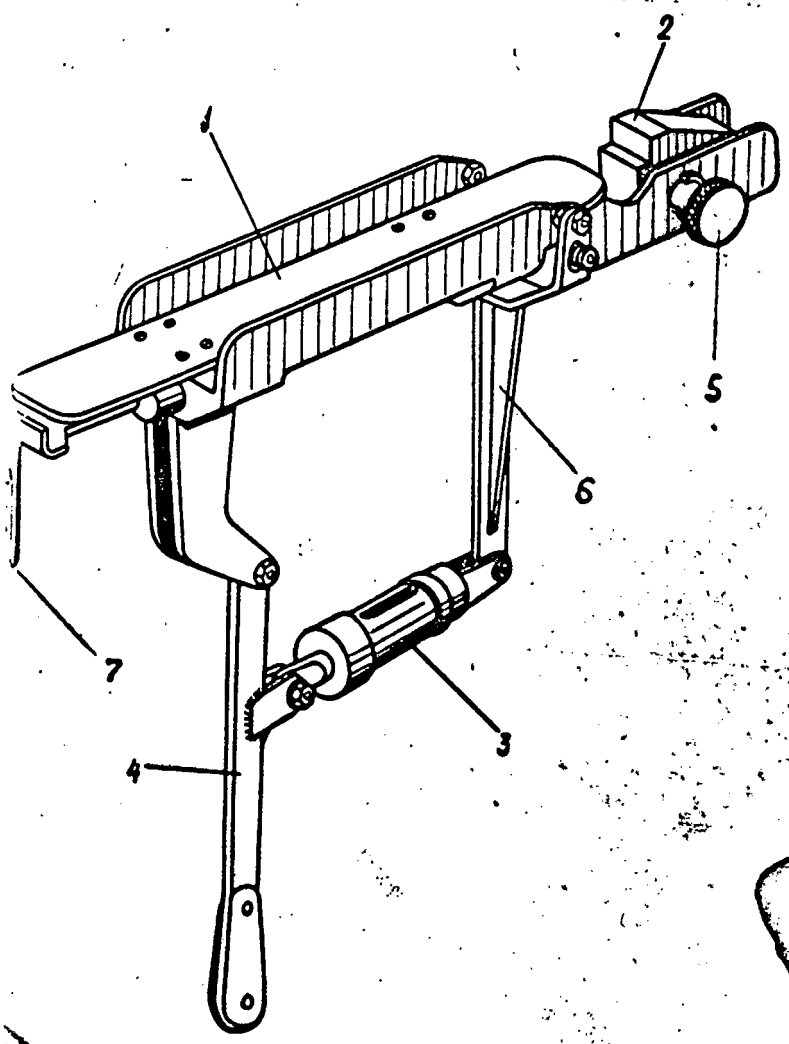

Фиг. 49. Приспособление для замера усилия отде
ракеты ЗУС-13.

1 - направляющая; 2 - ползун; 3 - динамометр;
4 - рукоятка рычага; 5 - ручка эксцентрикового в
6 - рычаг; 7 - упор.

Fig. 49. ZUS-13 Device for Measuring Missile Release Force.
1. guide; 2. sliding block; 3. dynamometer; 4. lever arm;
5. knob of eccentric bolt; 6. lever; 7. support

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WARNING: According to the inscription on the panel the panel should be checked with the aid of special instrument PP-II-13A not less than once every three months.

4. MEASURING THE MISSILE RELEASE FORCE FROM THE LAUNCH MECHANISM

The force required for the missile to separate from the launch mechanism [hold-down force] is measured with the aid of the ZUS-13 device after every ten launchings and during the performance of routine operations. (Fig 49).

Operations for measuring the missile release force should be performed in the following order:

1. Check the condition of the working surfaces of the device and smooth any nicks, barbs, or scabs that are found with fine emery paper.

2. Check that the TKhP-13 device guides do not seize in the launch mechanism guides after tightening the suspension stirrup with a torsion wrench.

3. Insert the steel plate of the device into the APU-13 guide slots and move the device forward until the plate support rests at the end of the groove.

WARNING: The launch mechanism should be disconnected during work with the [210] ZUS-13 device.

4. Put the dynamometer ring in the zero position.

5. Turn the knob of the eccentric bolt clockwise as far as possible and make sure that during this process the slide block of the device engages the front roller support of the catch of the launch mechanism.

6. Smoothly shift the lever of the device in the direction of the missile's flight until the slide block, having pressed the catch

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of the APU-13, slips behind the roller support, which should occur at a force of not less than 280 kg.

The release force is measured by the position of the movable ring in relation to the dynamometer scale, which is numbered every 20 units from 280 to 450.

After completing the check remove the device from the launch mechanism.

NOTE: The device should be recalibrated not less than once every 6 months with the aid of the special device PT-ZUS-13.

5. PREPARATION AND SUSPENSION OF THE MISSILE

The missiles are prepared for combat use in the same position in which their preliminary preparation takes place, according to the instructions on the part.

Before suspending the prepared missiles it is necessary to: [211]

1. Examine the armament aggregates in the cockpit.

2. Take the necessary measures to exclude the possibility of accidental launching or other incidents while the missiles are being attached.

3. While the suspending operations are going on, set up red flags (lanterns) warning that walking or driving near the aircraft is forbidden in this area.

4. Examine and check the working order of the components of the suspension system.

5. Check the working order of the launch control system with the aid of the II-13A console. After the check, switch on all circuit breakers of the control system.

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6. Examine the exterior of the missiles.

Check that the parts have no mechanical defects and also check the condition of the guides.

7. Wipe off the guides and insert the safety pin with the flag into the opening of the launch mechanism.

8. Press the locking rod button of the forward fairing of the launch mechanism and, while pressing it, turn the hooks which lock the fairing in the direction of the arrow. Tilt the unlocked fairing upwards.

9. Raise the missile and align its forward and middle guides with the grooves of the APU-13, insert the guides into the grooves and move the missile forward in the grooves of the launch mechanism up to the front roller support of the catch, having first lifted it by turning the wrench. When the wrench is released, the rear support should catch lightly and [212] without jamming and engage the missile guide.

10. Connect the pins of the plug connector of the missile to the socket of the launch mechanism.

11. With the aid of the catches on the SR-20 connector, tighten the bracket which is located on the forward fairing of the launch mechanism.

12. Close the forward fairing and check that it is securely fastened by the alignment of the control markings "Closed."

13. By tilting the missile in a vertical direction, make sure that the missile guides are securely fastened in the launch mechanism.

In a locked position the forward end of the missile guide should rest against the roller, and the rear end, on the slope of the catch projection.

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When moving the missile along the axis of the aircraft there should be a play of 0.1 - 1 mm.

14. The security of the locking of the missile guides is checked by the control markings inscribed on the double-arm lever and on the plate projections of the forward antivibrator of the launch mechanism. When the lever marks move beyond the limit of the antivibrator marks in the direction of decreasing the overlap, it is necessary to move the catch counterclockwise with the aid of the wrench. [213]

6. PROCEDURE FOR REMOVING UNUSED MISSILES

Missiles are removed from the launch mechanism in the following situations:

a) at the appearance of any defects in the launch control system;

b) in case the plane lands with unlaunched missiles;

v) at the concellation of a repeated takeoff;

g) to check the missile apparatus.

To remove the missiles from the airplane it is necessary to:

1. Take all necessary precautionary measures.

2. Make sure that the battery and circuit breaker switches of the missile's power supply and launching circuits are switched off in the airplane cockpit.

3. Insert the safety pin into the opening of the launch mechanism.

4. Put the protective cap on the missile head, the protective covering on the optical fuse section, and the rubber caps on the missile rudder to protect the reaction contacts of the proximity fuse.

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5. Open the fairing of the APU-13 and detach the plug connector. [214]

6. With the aid of a wrench raise the stop catch and antivibrators of the launch mechanism.

7. Smoothly guide the missile back by hand, pull the missile guides out through the guide slots of the APU-13, and lower the missile onto the AT-13 truck:

It should be remembered that, according to the documentation on the missile, the missile should be rechecked by the PPP-13A:

a) after thirty days' storage on the APU-13;

b) after five flights by the plane with unlaunched missiles;

v) not later than 24 hours after snow or rain falls directly on the missile.

CHAPTER V [215]

TECHNICAL MAINTENANCE OF THE INSTRUMENTS FOR PHOTO-MONITORING AERIAL FIRING

1. GENERAL INFORMATION ON THE PHOTO-MONITORING EQUIPMENT

The SSh-45-1-100-OS gun camera (Fig. 50) with the VM-2 timing mechanism is mounted on the airplane for photo-monitoring aerial firing.

The timing mechanism assures continuation of the operation of the FKP until the third second after the firing button is released.

The grid of the instrument is a glass plate with cross hairs and a scale line. The cross hairs are for adjusting the gun camera, and the scale line, for determining the scale when deciphering.

An alignment adapter is attached to the instrument for making the alignments.

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Фиг. 50. Комплект фотопулемета СШ-45-1-100-ОС
1-фотопулемет; 2-прицельная насадка; 3-кассета со снятой крышкой;
4-крышка кассеты; 5-кассета; 6-кронштейн для установки фотопулемета.

Fig. 50. Components of Gun Camera SSh-45-1-100-OS

1. gun camera; 2. fire-alignment adapter; 3. cassette with lid removed; 4. cassette lid; 5. cassette; 6. bracket for mounting gun camera

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The objective has a ring for setting the aperture. A prismatic attachment is screwed on the end of the objective and attached by two clamps. On the cover of the instrument is a disc indicator, the rotation of which serves to indicate advancement of the film when photographing.

Basic Technical Data of the Gun Camera

1. Focal length	- 100 mm
2. Relative aperture	- f:5.6; f:8; f:11
3. Acceptance angle of the instrument	- 14°15' x 19°18'
4. Frame size	- 34 x 25 mm
5. Exposure rate	- 5±1 frame per sec [217]
6. Amount of film in one cassette	- 3.6 m
7. Shutter speed (constant)	- 1/150 sec
8. Weight with loaded cassette	- 1.25 kg (total assembly- 4.15 kg)
9. Electric heating element	- 36 watts ± 10%
10. Total power consumption	- not more than 95 watts
11. Maximum range for photographing targets 10 m in size	- 1100 m
12. Maximum range for photographing targets 21 x 17 m in size	- 2000 m

Basic Technical Data on the VM-2 (Fig. 51)

1. Time setting	- from 0 to 3 sec
2. Weight	- 1.2 kg
3. Input current at a voltage of 27 volts ± 10%:	
with electric heater	- not more than 1.32 amps
with electromagnet	- not more than 2.05 amps

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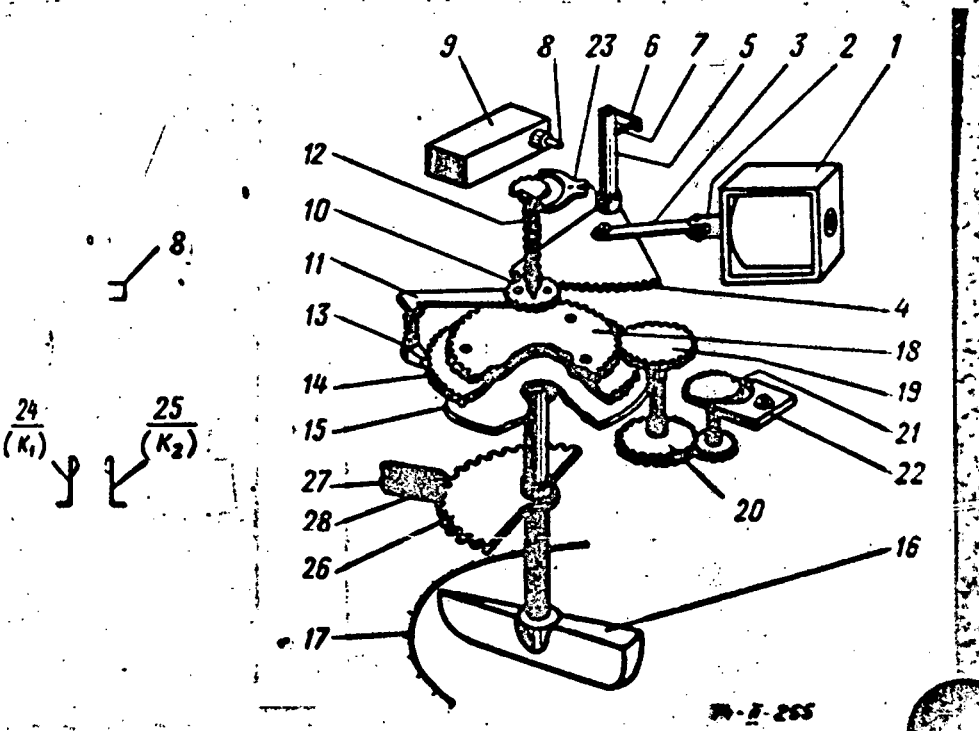

Fig. 51. Construction of the VM-2 time mechanism
(Functional Diagram)
(Key is on a separate page)

Рис. 51. Конструкция временного механизма ВМ-2 (кинематическая схема).

1 - электромагнит; 2 - сердечник; 3 - тяга; 4 - зубчатый сектор; 5 - ось; 6 - кривошип; 7 - вилка; 8 - шток переключателя; 9 - переключатель; 10,18 - шестерни; 11 - рычаг; 12 - заводная пружина; 13 - собачка; 14 - храповое колесо; 15 - дисковая кулачка; 16 - бугелек; 17 - шкала; 19,20 - паразитные шестерни; 21 - колесо анкера; 22 - палка анкера; 23 - вилка; 24,25 - контакты; 26 - зубчатый сектор; 27 - пружина; 28 - шарн.

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Fig. 51. Construction of the VM-2 Time Mechanism

(Functional Diagram)

1. electromagnet; 2. core; 3. pull rod; 4. segment gear; 5. shaft; 6. shaft arm; 7. screw; 8. switch rod; 9. switch; 10, 18. gears; 11. lever; 12. winding spring; 13. pawl; 14. ratchet wheel; 15. disc cam; 16. handle; 17. scale; 19, 20. idle gears; 21. anchor wheel; 22. anchor fork; 23. fork; 24, 25. terminals; 26. segment gear; 27. spring; 28. ball.

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The gun camera is operated from the firing button located on the control stick of the airplane. During this process the circuit breakers "FKP" and "NR, SS, RS, FKP" on the right panels should be switched on. The position of the sight selector switch is immaterial.

The working time of the VM-2 mechanism is set by a handle located on the cover of the instrument.

On the same cover is a selector switch for switching the gun camera to operation with the timing mechanism or without it. [219]

A four-pin plug connects the timing mechanism with the gun camera, and a three-pin plug connects it with the aircraft network and the relay contact operated from the firing button. The heating and switching circuits of the gun camera motor are fed through VM-2.

The time scale is marked from 0 to 3 seconds every half second.

The heating elements of the gun camera and VM-2 are switched on with the aid of their thermoregulators.

The gun camera thermoregulator turns on the heating element at a temperature below +3°C and turns it off at a temperature of +30°C..

The VM-2 thermoregulator turns on the heating element at a temperature of -2°C and turns it off at a temperature of +15°C.

2. INSPECTING AND TESTING THE TECHNICAL CONDITION OF THE GUN CAMERA [220]

When inspecting the gun camera it is necessary to check:

1. That there is no damage to the projecting parts and joints of the instrument.

2. That there are no cracks or splits in the plastic parts.

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3. The security of the fastening of the bracket and the ball-and-socket joint.

4. The security of the fastening of the prismatic attachment to the lens of the instrument.

5. The working order of the catch on the cover of the housing.

6. The fastening of the plug connector to the instrument output contacts and the condition of the cable shielding.

7. The condition of the unit and details which can be examined without dismantling the instrument when the cover is open and the cassette is removed.

8. The cleanness and condition of the velvet liner and tightness of fit of the lids of the cassettes, which are preloaded in the photographic laboratories.

9. The condition and cleanness of the optical parts and the cleanness of the frame window.

In order to avoid scratching the optical system, it should be cleaned only when it is dirty. A flannel rag, soft brush, or absorbent cotton may be used for this purpose. Oil spots should be removed from the [221] optical parts with the aid of cotton moistened in distilled alcohol.

10. The absence of foreign objects inside the cassette and chamber of the instrument.

11. The cleanness of parts with which the film comes in contact. These parts should be carefully wiped with a cloth moistened with aviation (un-leaded) gasoline.

In the event that the instrument is stored for a long time before it is used, it is necessary to grease the grooves of the Maltese cross socket

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lightly. For cleaning when using the alignment cassette, line up the grooves of the Maltese cross socket with the openings. Greasing should be done with a small brush. Do not pack the grease thickly.

Preservation and storage of the gun camera photographs should be carried out according to the instructions of the manufacturer.

3. CHECKING THE WORKING ORDER OF THE GUN CAMERA CONTROL SYSTEM [222]

The working order of the gun camera can be checked separately or together with the controls of other armament systems.

In each separate instance of preparation for flight, a check must be made with the sight selector switch in the position that corresponds to its combat mission (Fig. 52).

WARNING: The FKP controls can be checked together with the combat araments control systems only when the weapons are disarmed and there are no rockets attached.

Conduct the check in the following order:

1. Examine the outside of the gun camera and test its technical condition.

2. Connect the ground source of electricity to the aircraft circuit.

3. Switch on the "Battery aircraft, airfield" switch and the "FKP" circuit breaker on the right front panel.

4. Switch on the "NR, SS, RS, FKP" circuit breaker on the right back panel.

5. Set the sight selector switch in the position that corresponds to its combat mission.

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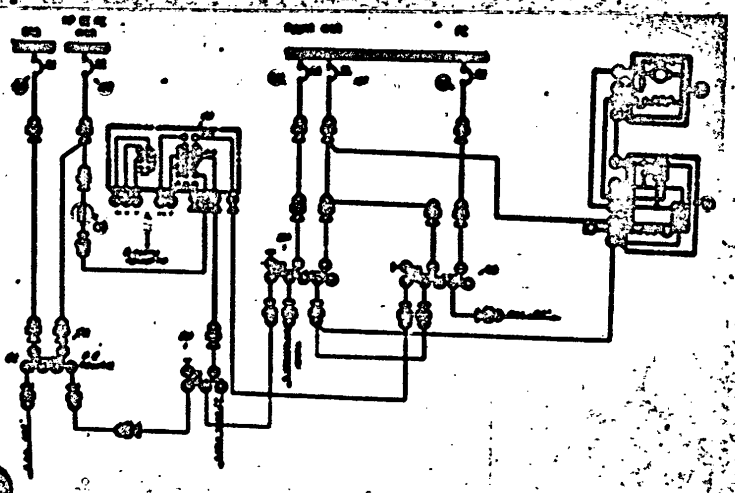

Fig. 52. Electric feeder schematic for FKP controls

Рис. 52. Принципиальная электрическая схема управления ФКП.

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Fig. 52. Electrical Supply Schematic for FKP Controls [p 224]

6R - range-only radar circuit breaker

14B - RS circuit breaker

16P - sight control panel

17P - firing button circuit breaker

18P - firing button

24P - "RS, Gun-SS" firing selector switch

25P - gun circuit breaker

26P - relay for switching on "SS" and "Gun" firing circuits

28P - relay for switching on armament and FKP

41P - relay for switching on "RS"

42P - gun camera

43P - timing mechanism

16P - sight control panel

19P - FKP circuit breaker

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6. Press the firing button and note whether the camera electric motor works the entire time that the button is held. [225]

7. Place the selector switch on the time mechanism in the "On" position and the handle to the marking for the working time of VM-2 that corresponds to its mission.

8. Press and release the firing button and note whether, after release of the button, the gun camera continues to work for the duration of the time set by the handle of the timing mechanism.

9. Turn off the circuit breaker and the battery which were switched on to check the working order of the gun camera control system.

4. LOADING THE GUN CAMERA [226]

Loading the gun camera involves loading the film cassette and placing it in the instrument.

Loading the Cassette

The cassette is loaded in the photographic laboratory, in darkness or with artificial light of a certain color and intensity, depending on the film used.

The photosensitivity and chemical composition and type of film emulsion are selected in relation to the lighting of the object.

To load the film it is necessary to:

1. Open the catch and remove the lid of the cassette.

2. Remove the driven spool.

3. Remove the detainer from the driven spool.

4. Place the emulsion side of the film towards the driven spool and attach its end to the entire length of the detainer. Do not bend film or allow it to protrude beyond the end of the spool.

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5. Wind the 3.6 meters of film onto the spool with the emulsion inside.

6. Cut the end of the film at a right angle, place the spool in the cassette, and at the same time, pass the film from above between the wall of the cassette and the film plate slide rails for the entire length from the roll to the film winder.

7. Feed the film to the film winder and, turning it by the sprocket, wind the film on the drive spool.

8. Fasten the end of the film on the drive spool with the emulsion coating outwards. [227]

9. Put on the lid of the cassette, latch it, and, turning the sprocket of the geared spool, make sure that the film winds smoothly.

10. With a soft pencil write on the film the date that the cassettes were loaded and arrange to store them in such a manner that the possibility of exposure is eliminated.

Placing the Loaded Cassette in the Instrument

The loaded cassette is placed in the gun camera when the plane is being prepared for take-off. First, it is necessary to:

1. Examine the outside and check the condition of the optical parts.

2. Check the alignment with the aid of the alignment adapter.

3. Test the operation of the electric motor from the firing button.

4. Examine the cassette that was loaded in the laboratory.

During this examination:

a) Make sure that the lid of the cassette is firmly latched;

b) By turning the sprocket of the geared spool, make sure that the film winds smoothly;

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v) In darkness or in low-intensity illumination make the necessary inscriptions on the film through the frame window with an ordinary soft pencil without releasing the pressure plate.

Loaded cassettes must be wrapped in black paper if they are to be [228] stored for an extended period.

When inserting a loaded cassette into the instrument it is necessary to:

1. Open the cover of the instrument.

2. Place the cassette into the instrument, parallel to the walls of the case, making sure that the film comes up to the frame window of the instrument.

3. Close the cover lid of the instrument, placing the coupling pegs of the disc indicator in such a fashion that the key of the driven spool comes between the pegs of the disc. The lid should be carefully closed and the catch securely fastened.

4. Turning the disc indicator that advances the film, be sure that the key of the driven spool is between the pegs of the disc indicator.

5. Set the required aperture and light filter, depending on the expected exposure conditions.

The aperture is set by turning a movable ring on the objective.

6. Check by brief engagement the operation of the gun camera and film advance. During this time all measures should be taken to exclude the possibility of accidental firing of the gun.

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CHAPTER VI [p 229].

/ Technical Maintenance of the Drop Fuel Tank

1. General Information

The pylon for the drop tank is attached by means of two bolts under the fuselage along the axis of the aircraft at frames #16 and #20. (Figure 53)

The tank is suspended from the pylon by means of lock BDZ-56Ye, on the carrying arm of which an eye-bolt is attached.

At the nose of the pylon and the rear bolt are pipes which connect the fuel intake pipe and the pressurized tank pipe to the corresponding pipes in the fuselage.

A special explosive pusher mechanism and charge-driven piston installed in the pylon provide for emergency release of the tanks in flight.

The explosive piston is armed with two shells, type PK-ZM-1.

Mechanical release of the carrying arm of the lock for a test jettisoning of the drop tank is provided through an opening in the right wall of the pylon.

Jettisoning the tank in flight is done by pressing the "Sbros baka" (tank jettison) button on the left side of the instrument panel.

Power is applied from the circuit breaker "Avar. sbros baka, RS, APU. Avar. pusk SS". (Emergency Jettison of Fuel Tank, Rockets, APU. Emergency Launch of Missiles) through the jettison button to the emergency winding of the electromagnetic launch mechanism. The circuit breaker is located on the rear electrical panel on the right side of the cockpit. [p 231]

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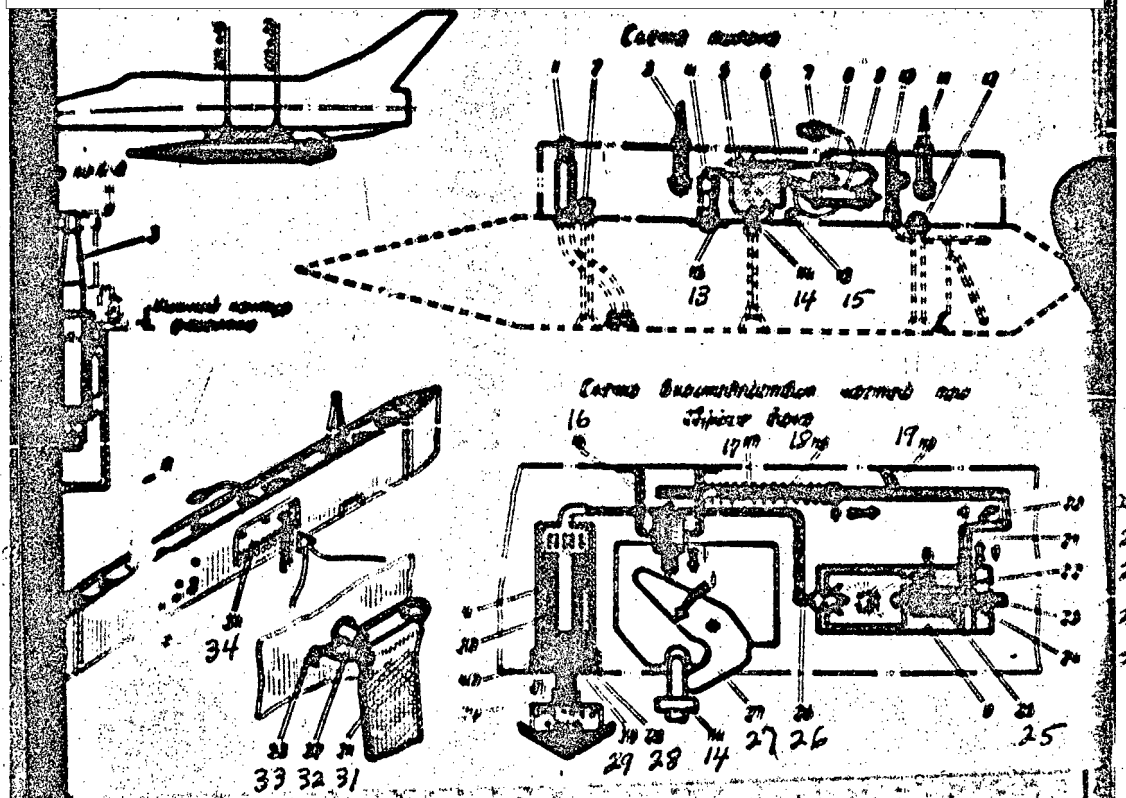

Fig. 53. Pylon for drop fuel tank and its firing mechanism
(Key is on a separate page)

Рис. 53. Пилон для подвешивания топливного бака и его управление.

1- передняя трубчатая балка пилона; 2- задний упор; 3- передний кронштейн; 4- шпренгель; 5- замок ЗПЗ-6П; 6- задний кронштейн; 7- вспомогательный замок ЗП-4; 8- передний кронштейн; 9- кронштейн; 10- задняя трубчатая поперечина пилона; 11- задний кронштейн; 12- задний упор; 13- замковый кронштейн, крепящийся задним болтом к балке пилона и передним болтом к кронштейну; 14- узел подвески бака (разъем); 15- упор в баке; 16- стакан; 17- тяга; 18- пружина; 19- качалка; 20- качалка; 21- вилка (серьга); 22- осевая тяга; 23- упорка; 24- ролик с упорками; 25- пружина; 26- трубопровод; 27- верхний ремень; 28- бронзовая вилка; 29- качалка подвески с упором; 30- подшипник; 31- ролик крепления; 32- подвижной кронштейн; 33- буксина; 34- ось вилки к кронштейну; 35- контровка; 36- гайка; 37- шайба; 38- гайка; 39- гайка; 40- нижняя гайка.

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Fig. 53. Pylon for drop fuel tank and its firing mechanism [230]

1-fuel intake adapter line; 2-front support; 3-front coupling bolt; 4-pusher mechanism; 5-BDZ-56Ye lock; 6-spring trigger mechanism; 7-ShR-4 plug connector; 8-plug connector; 9-charge-driven piston mechanism; 10-pressure adapter line; 11-rear coupling bolt; 12-rear support; 13-end-actuated microswitch signalling attachment of tank and locking of lower air brake release with drop fuel tank; 14-tank attachment lug (eye-bolt); 15-support inside tank; 16-stop; 17-pull rod; 18-spring; 19-rocker; 20-cocking rocker; 21-fork; 22-check bar; 23-firing pin; 24-firing pin ball; 25-main spring; 26-tube; 27-lock carrier lever; 28-shearing washer; 29-pusher and support connection pin; 30-pusher; 31-red signal flag; 32-safety locking pin; 33-safety pin; 34-access to piston mechanism; 35-lock nut; 36-nut; 37-washer; 38-nut; 39-nut; 40-end nut.

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Fig. 54. Drop tank lock BDZ-56Ye
1-case; 2-stirrup; 3-connecting arm; 4-ball bearing; 5-ballbearing axle; 6-supporting arm; 7-microswitch; 8-lever; 9-cover plate; 10-connecting arm; 11-spring; 12-connecting arm; 13-(key?); 14-electromagnetic releasing mechanism; 15-lifting arm; 16-carrying arm; 17-catch; 18-spring; 19-tube.

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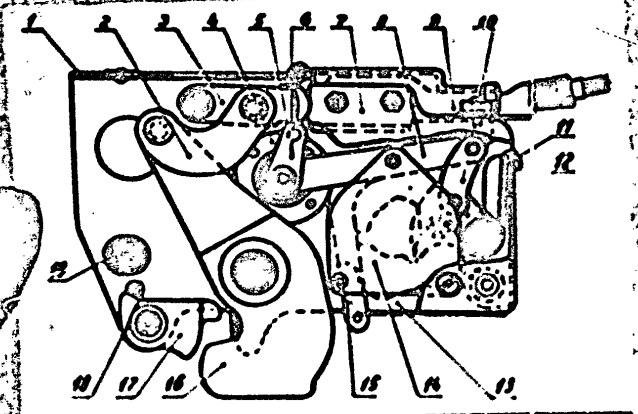

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A signal light "Podveska baka" (Tank Attachment), located on the lower electrical panel of the instrument panel, is used to monitor attachment and jettisoning of the tank.

A signal indicating suspension of the tank is provided by means of a microswitch located in the pylon. When the microswitch is pushed in, it blocks opening of the third air brake while the tank is suspended.

Access to the firing mechanism is through a small access door having an opening in its cover for installation of the ground safety pin.

Basic Information on the Use of the BDZ-56Ye Lock (Fig. 54)

1. Triggering voltage	27 v ± 10%
2. Minimum triggering voltage	20 v
3. Operating temperature range	+50°C to -?9°C
4. Weight	3.370 kg
5. Plug connector	[ShR38Pk7YaG9 ?]

The lock is attached to the pylon by means of two bolts.

The carrying arm of the lock is held in the closed position when the pawl (tooth) of the [key ?] of the electromagnetic mechanism engages the [sector-type ?] lever.

The size of the [illegible] sector of the pawl [illegible] over the entire surface should be no less than 2.5 mm and no more than 3.0 mm. [p 23.

The lock is closed at the cocking lever by means of a wrench.

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2. Installing the Pylon on the Aircraft

1. Before the pylon is installed on the aircraft, it is necessary, at the fuselage:

a) to remove the plug closing the outlet of the fuel pipe, check that it is clean and check to see that the ring gasket is in place in the connecting pipe;

b) to remove the cover of the small hatch for access to the plug-and-jack assembly of the microswitch and lock BDZ-56Ye and then disconnect the plug from the fuselage;

v) to examine the nozzle (nipple) of the pressure line, making sure that it is clean and that the ring gasket is in place inside the connecting pipe;

g) to examine the sockets under the forward and rear bolts which attach the pylon, checking their clean condition and the working order of the threads;

2. Examine the pylon and make sure that it is in working order. This examination requires the following steps:

a) remove the servicing caps from the ends of the fuselage adapter line and the pressure line, make sure they are clean and that the rubber ring gaskets are properly in place at the lower ends of the pipes. Check the possibility of a displacement of the removed pipe [up to 6 mm ?] in the direction of the longitudinal axis of the pylon; [p 234]

b) check the cleanness and working order of the receptacles under the forward and rear supports of the suspended tank;

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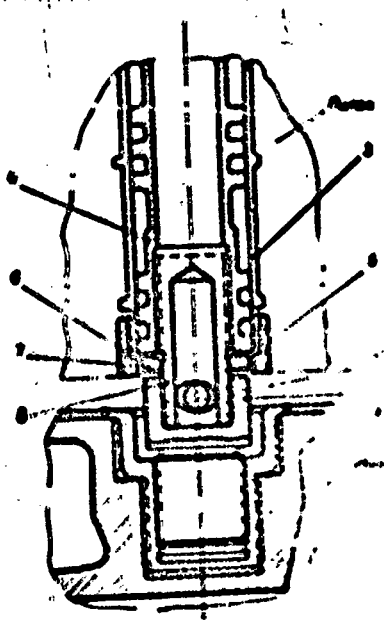

Рис. 55. Приспособление системы сбрасывания подвесного бака.

1-упор приспособления; 2-[illegible]; 3-цилиндр; 4-поршень; 5-[illegible]; 6-[illegible]; 7-[illegible]; 8-приспособление.

Fig. 55. Charge-driven pusher mechanism for the drop tank jettisoning system

1-pusher mechanism support; 2-prong; 3-cylinder; 4-piston; 5-ring nut; 6-special washer; 7-lock nut; 8-pusher mechanism.

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v) unscrew the sleeve nut, remove the cap from the cylinder of the explosive pusher mechanism (Fig. 55) and make sure that the inside of the cylinder is clean;

g) install the BDZ-56Ye lock. If it is already in place, make sure it is attached properly and check for mechanical wear;

NOTICE: COCKING THE CARRYING ARM OF THE LOCK IS DONE ONLY AFTER THE SPRING MECHANISM IS COCKED.

d) d) press the [stop ?] of the microswitch and, according to the "click" sound, check its disengagement and engagement; then check the protrusion of the rod, which should be 25 millimeters from the lower edge of the pylon to the head of the rod;

ye) open the small hatch and see that the piston mechanism is properly attached, check the condition of the piping, the attachment and the [operation ?] of the connecting rods at the rocker of the spring mechanism, and the condition of the electric wire leading to the switch terminal;

NOTICE: ATTACH, ADJUST, AND REMOVE THE PYLON WITH THE CHARGE-DRIVEN PISTON MECHANISM LOADED.

zh) check the cleanness of the connecting pipe to the vacuum-[system ?]. Check the ease of opening and closing of the valve by pressing down on the valve with the bent end of a wire through the input pipe. [p 236]

3. Remove from the pylon the front and rear bolts by removing the nuts with the appropriate socket wrench.

4. Attach the front and rear bolts to the respective sockets in the fuselage by tightening their special nuts all the way up.

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5. Bring together the pylon and fuselage and connect the plug of plug connector ShR-4 with the socket in the fuselage, first removing from the socket (in the fuselage) the special plug with the seal.

6. Align the pylon with the fuselage by matching the openings for the bolts and pipe in the pylon with the corresponding bolts and pipe on the fuselage; place a steel washer over the end of the bolts, turn up the nuts, tighten them with the socket wrench, and fasten the lock nuts.

7. Test the operation of the piston mechanism by using a blank cartridge or a [cartridge-holding disk ?] and pushing the tank jettison button.

8. Load the piston mechanism with a PK-3M-1 cartridge and set the [illegible] safety catch.

NOTICE: THE CARTRIDGE IS INSTALLED ONLY WHEN THE TANK IS SUSPENDED.

9. Before suspending the tank, set the spring mechanism and close [p 237
lock BDZ-56Ye.

After the tank is suspended, test its tightness in contact with the fuselage.

Removal of the pylon from the aircraft is done in the reverse order.

After removing the pylon, connect the plug with the [connecting pipe ?] to the receptacle and attach to the fuselage.

NOTICE: WORK ON THE INSTALLATION AND REMOVAL OF THE PYLON IS TO BE DONE ONLY IN THE PRESENCE OF AN AVIATION TECHNICIAN.

When no tank is present, the [lower ?] part of the pylon should be covered with the protective cover and the fuel intake pipe plugged.

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3. Installation of Lock BDZ-56Ye [p 238]

Prior to installation, the completeness and condition of the lock and of the pylon must be checked.

The installation of the lock on the drop tank pylon is done according tothe following steps:

1. Remove from the pylon the two special bolts for attaching the lock.

2. Pass the cable with the electrical plug connector to the inside of the pylon and through the access of the piston mechanism; connect the plug with the female part of the cable extending out of the fuselage, and then connect the plug to the lock.

3. Set the lock in the pylon and attach it with the bolts previously removed from the pylon.

4. Test the mechanical response of the lock and the electrical response from the controls in the cockpit.

4. Cocking the Spring Mechanism of the Charge-Driven Piston Mechanism and the BDZ-56Ye Lock [p 239]

If no tank is present, the spring mechanism and the lock should be extracted and the piston mechanism unloaded.

The spring mechanism (Fig. 56) and the lock are cocked before the tank is suspended and after the piston mechanism is loaded.

The operation is done in the following sequence:

1. Into the end of the shaft marked "Vzvod" ("Cock"), located on

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Fig. 56. Spring mechanism of the tank jettisoning system
1-detent; 2-connecting rod; 3-spring; 4-sleeve; 5-connecting rod; 6-rocker; 7-lever; 8-lock carrying arm; 9-piston mechanism; 10-fork; 11-cocking shaft; 12-pin.

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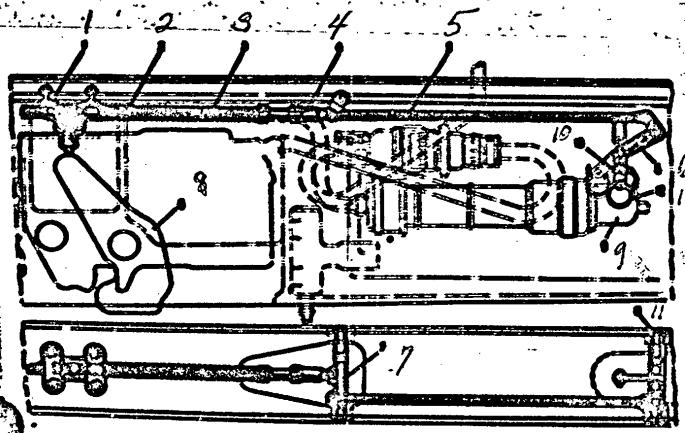

Рис. 56. Пружинный механизм сбрасывания баков
1-стопор; 2-тяга; 3-пружина; 4-втулка; 5-тяга; 6-качалка; 7-рычаг; 8-запирающий рычаг замка; 9-поршень; 10-вилка; 11-ось взвода; 12-палец.

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the left side of the pylon, insert the key and turn counterclockwise to wind the spring mechanism.

2. Secure the spring mechanism in the cocked position by engaging the fork of the spring mechanism with the bracket lug on the piston mechanism bolt by means of a pin.

NOTICE: THE SPRING MECHANISM IS COCKED ONLY WHEN THE LOCK IS OPEN.

3. Cock the carrying arm of the lock. The upper part of the carrying arm engages the pin of the spring mechanism and locks the spring mechanism in the cocked position.

To attach the lock:

a) press the carrying arm all the way forward by its lower protrusion;

b) holding the carrying arm in this position (forward), turn the cocking lever back (opposite the direction of flight) all the way to the stop, using the key located on it; [p 241]

v) check the contact area at the prong of the sear of the electromagnetic mechanism in order to make sure that the arm holder is correctly positioned.

4. Remove the pin from the bracket lug of the piston mechanism bolt and make sure that the spring mechanism is locked by applying slight pressure on the forked bracket in the releasing direction of the system.

5. Check the presence of the ground safety catch pin in the firing pin of the bolt assembly and connect the fork of the spring mechanism with the shear pin.

6. Close the cover of the access to the piston mechanism and con-

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nect the pin of the ground safety catch with the signal flag.

5. Testing the Working Order of the Suspension System and the Control of the Jettisoning of the Tank [p 242]

Whenever a new tank is attached, the working order of the suspension system and the control of the jettisoning are tested.

The testing is done in the following sequence:

1. Place the pin of the ground safety catch into the firing pin of the bolt assembly, disconnect the fork of the spring mechanism from the firing pin of the bolt assembly, and unload the piston mechanism, observing the indicated sequence.

2. Inspect the outside of the pylon, including:

a) the condition of attachment and seal of the pylon to the aircraft;

b) check the support sockets between the pylon and tank;

v) open the carrying arm of lock BDZ-56Ye by mechanical release. Check the elasticity and force of the lock springs. If the arms are contaminated, the lock must be removed from the pylon and washed;

g) check the condition of the visible parts of the spring mechanism and the attachment of the piston mechanism.

3. Load the piston mechanism with a blank cartridge or percussion cap.

4. Cock the spring mechanism and lock it into position.

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5. Raise the carrying arm of the lock, disconnect the fork of the spring mechanism from the bracket on the bolt of the piston mechanism, and check the reliability of the retention of the spring mechanism by the pin by lifting the upper shoulder of the carrying arm of the lock. [p 243]

6. Connect the fork of the spring mechanism to the firing pin of the bolt assembly.

7. Switch on the battery and the circuit breaker "Emergency Jettison of Tank, APU, RS. Emergency Launch of SS."

8. Press the rod of the microswitch and check to see that the suspension indicating lamp is burning. When the button is released, the lamp should go out.

9. Press the tank jettison button and check that the carrying arm of the lock has opened, that the spring mechanism has operated forcefully and [released ?] the firing pin, causing the release of the firing pin of the piston mechanism bolt.

10. Unload the piston mechanism and check the condition of the firing pin indentations in both percussion caps.

11. Repeat the control test of the operation by jettisoning an empty tank. In this case it is not necessary to load the mechanism in order to repeat the testing of the firing pin indentations.

The work on the control testing of jettisoning of the tank, as well as suspending it and servicing it, is done by an aviation technician in the order given in the first book of instructions. [p 244]

Upon completion of the testing, shut off the battery and circuit breaker and, if necessary, load the piston mechanism.

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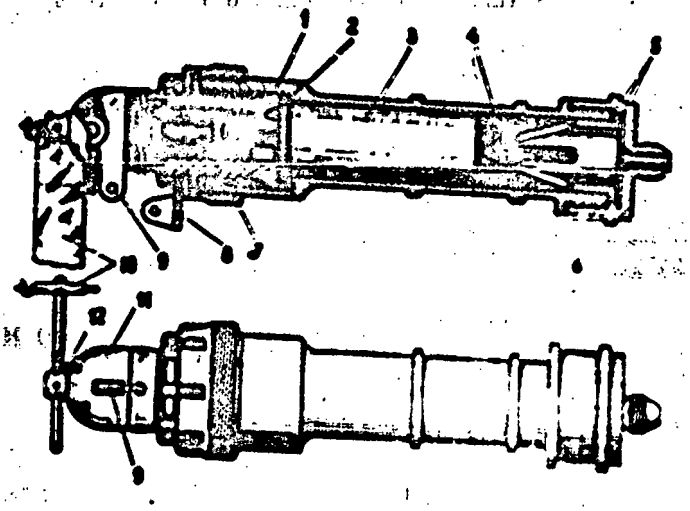

Фиг. 57 Пиротехнический механизм сбрасывания подвесного бака.

1-корпус; 2- центральный вал; 3- пироэлемент; 4-решетка; 5-прокладка; 6- крышка со штекером; 7-двухсторонний ударник; 8-установочный кронштейн с ухом; 9-боевая чека; 10-предохранительная чека; 11-болт; 12-шпилька для проверки пироэлемента.

Fig. 57. Charge-driven piston mechanism of the tank jettisoning system
1-case; 2-central shaft; 3-explosive cartridge; 4-grating; 5-packing;
6-cap with connector; 7-double-faced striker; 8-mounting bracket with
lug; 9-firing pin; 10-safety pin; 11-bolt assembly; 12-prong for
testing explosive cartridge.

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6. Unloading the Piston Mechanism

The piston mechanism is unloaded in the following order (Fig. 57):

1. Remove the signal flag from the pin of the ground safety catch and open the lid of the access hatch to the piston mechanism located on the left side of the pylon.

2. Remove the cotter pin and disconnect the pin of the piston mechanism bolt from the fork of the spring mechanism. Insert the pin in the opening of the fork.

3. Loosen the lock nut of the bolt assembly, turn the sleeve nut and remove the bolt assembly of the piston mechanism from the pylon.

NOTICE: IT IS FORBIDDEN TO [UNLOAD ?] THE PISTON MECHANISM WITHOUT [INSTALLING] THE PIN OF THE GROUND SAFETY CATCH.

4. Extract the explosive cartridge from the bolt assembly, for which it is necessary to remove the collar of the cartridge case from the prong, [illegible] the cartridge around the pin [of the face, of the mirror ?] and then remove the cartridge from the pin. Clean and check the condition of the bolt assembly.

The same order should also be followed in unloading the piston mechanism after jettisoning the tank. In this case, the parts of the firing mechanism [should be] cleaned of powder deposit in the following order:

1. Remove the sleeve nut and disconnect the pipe from the case of the piston mechanism. [p 246]

2. Remove the fastening collar of the piston mechanism and take it

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out of the pylon.

3. Remove the cartridge wadding from the cylinder and clean the cylinder of deposits. If necessary for cleaning, the nut can be removed and the grating taken out.

4. Turn the sleeve nut of the pusher mechanism cylinder, remove the remainder of the shear washer, and clean the cylinder of the pusher mechanism.

5. Using the bristle brush at the ends of the tube, clean it of soot and deposit, after which blow compressed air through the tube from the piston mechanism end.

6. Mount on the firing cylinder a new pusher mechanism with washer taken from the tank parts unit, install and connect the piston mechanism case with the tube, test the tank jettison control system and, if necessary, reload the piston mechanism.

7. Loading the Charge-Driven Piston Mechanism [p 247]

The piston mechanism is loaded on the following order:

1. Raise the bolt assembly, using the attachment to squeeze the firing pin out so that its end protrudes from the housing of the bolt assembly.

Into the opening of the firing pin insert the pin of the ground safety catch, after which the firing pin is inserted into the rectangular opening in the head of the bolt assembly and pushed all the way up.

2. Take the explosive cartridge and, rotating it around the shaft

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(pin) on the face, [place] the collar of the cartridge case under the prong of the bolt assembly. When the explosive cartridge is connected with the bolt assembly, it should be held up by the [illegible].

3. Do not [remove ?] the pin of the ground safety catch; insert the bolt assembly together with the cartridge into the case of the piston mechanism.

4. Turn the sleeve nut of the bolt assembly all the way up and securely tighten the lock nut, setting the lug of the bracket under the fork of the spring mechanism in such a way that, after the latter has been cocked to the lug, the fork can be reconnected.

5. Cock the spring mechanism and the BDZ-56Ye lock.

6. Check to see that the spring mechanism is correctly fastened.

7. Connect the firing pin with the fork of the spring mechanism.

8. Be sure that the end of the indicator which shows that the explosive cartridge is present (painted red) protrudes from the bolt housing and does not recede into it when pressed. [p 248]

9. Close the cover of the access and reconnect the signal flag to the pin of the ground safety catch.

NOTICE: REMOVAL OF THE GROUND SAFETY CATCH FROM A LOADED PISTON MECHANISM IS PERMITTED ONLY PRIOR TO TAKEOFF.

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CHAPTER VII [p 249]

Maintenance of the Initiator for Emergency Jettisoning of the Canopy

1. General Information

The initiator shown in Fig. 58 is installed in the emergency canopy jettisoning system and consists of the cartridge case and bolt assembly with firing pin, arming spring, dashpot, releasing lever, and two nuts.

The case of the explosive cartridge is connected by two connecting pipes with the piping of the initiator for jettisoning the canopy. The sleeve nuts of the connecting pipes are joined by KO-KO.8 wire.

The cases are connected by means of the large nut of the bolt assembly. After being tightened, the nut is joined to the second bolt assembly nut and the piping connector by KO-KO.8 wire.

The stroke of the firing pin after release is equal to 7.0 ± 0.5 mm. The firing pin should extend from 1.6 to 1.9 mm.

In the recess of the firing-pin shaft is a roller which engages the releasing lever and holds the firing-pin in the cocked position.

Once the firing-pin is cocked, the release lever is held to the dashpot case by MIM-KO.5 [copper] wire.

The firing pin of the initiator is triggered by the automatic canopy jettisoning handle located on the right-hand panel under the canopy.

When the canopy is closed, the upper lever of this handle is located [p 251] in the recess of the triggering actuator of the initiator.

In order to jettison the canopy, the grip must be shifted to the horizontal position and then tilted backward.

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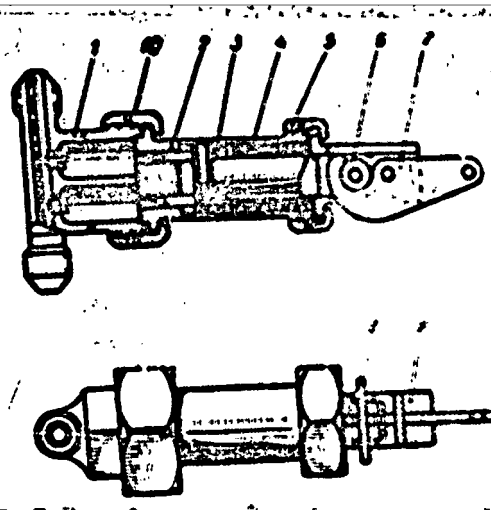

Fig. 58. Initiator for emergency jettisoning of the canopy
1-cartridge case; 2-bolt-assembly case; 3-firing pin; 4-arming spring; 5-nut; 6-roller; 7-release lever; 8-axle of roller; 9-dashpot; 10-nut for connecting the cases

Рис. 58. Пироинсталят системы аварийного сбрасывания фонаря.
1 - корпус патронника; 2 - корпус затвора; 3 - ударник; 4 - боевая пружина; 5 - гайка; 6 - ролик; 7 - рычаг спуска; 8 - ось ролика; 9 - стаканчик; 10 - гайка соединительных корпусов.

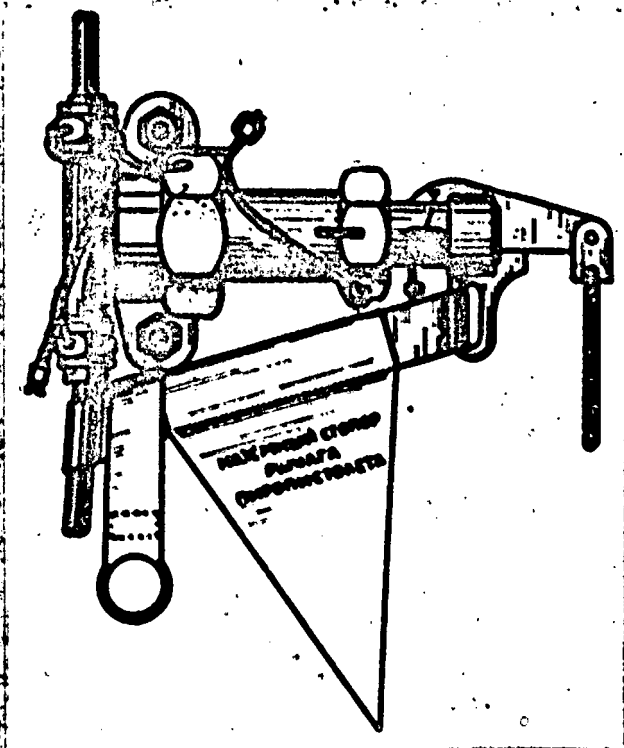

Fig. 59. Location of ground safety lock on emergency canopy jettisoning initiator

Рис. 59. Установка наземного стопора в пироинсталят системы аварийного сбрасывания фонаря.

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Setting the grip in the horizontal position switches on a diaphragm valve through which air from the [feed] bottle is admitted through the perforated diaphragm into the cylinder of the canopy elevator and into the cylinder of the temporary catch lock.

When the grip is shifted 20-30 mm toward the operator, its upper lever arm presses on the shaft of the triggering actuator and, with the aid of the cable actuator, turns the release lever (sear) of the initiator which fires and disconnects the canopy.

Further travel of the grip pulls a pin which connects a valve which bleeds powder gas from the TSM-2500-38 initiator.

After the pin of the initiator bleed valve has been pulled, the grip should still have a play of not less than 5 mm.

Powder gases in the piping flow to the cylinders, opening the canopy locks. When the locks open, the pressure of the air fed to the elevator cylinder causes the canopy to jettison.

2. Unloading and Loading the Initiator for Emergency Jettisoning of the Canopy [p 252]

The unloading and loading of the initiator for the emergency jettisoning of the canopy is done at times established by regulations.

During unloading and loading of the mechanism, measures must be taken to prevent accidental detonation.

When replacement of explosive cartridges is involved without detachment of the jettisoning system, the unloading and loading operations are done in the following sequence:

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1. Unlock and remove the nut connecting the cases of the initiator and remove the bolt assembly together with the wiring from the chamber.

2. Remove the cartridge from the chamber.

3. Clean the cartridge chamber and the face of the bolt assembly.

4. Insert a new PV-1 explosive cartridge into the chamber.

5. Insert the centering shaft of the bolt assembly into the female receptacle of the chamber and tighten up all the way the threaded nut of the bolt assembly which connects the initiator cases.

After the nut has been tightened, attach the safety wire KO-KO.8 to the small nut of the bolt assembly and the connecting pipe of the piping system, and then attach the ground safety catch (Fig. 59).

NOTICE: The nut which connects the cases of the initiator must be drawn up tight; otherwise, when the firing pin is released, the bolt motion will not be sufficient and no detonation will take place. For the same reason, the gap between the end of the nut and the collar of the initiator, after tightening, should be not less than 0.5 mm. [p 253]

3. Testing the Operation of the Canopy Jettisoning Initiator

The testing of the operation of the initiator is done once a year with simultaneous testing of the operation of the diaphragm valve, the emergency canopy jettisoning system, and the bleed valve of initiator TSM-2500-38.

Work on the detonation of the initiator should [be done] in accordance with regulations by [authority of "SN" ("SK"?)].

The detonation is done in accordance with the execution of this

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operation to be found in the first book of instructions.

During all tests of the operation of canopy mechanisms and the operational reliability of the bolt assembly, the initiator should be unloaded.

Detonation is done only with blank cartridges and percussion caps.

NOTICE: The use of an armed cartridge for the detonation of the initiator is categorically forbidden.

After completion of the detonation, it is necessary to:

1. Disconnect the [nut of] the cases of the initiator and disconnect the bolt assembly from the chamber.

2. Withdraw the blank cartridges from the chamber and check to see that their caps are demolished; the deviation of the mark of the firing pin from the center of the percussion cap of the blank cartridge, according to a measurement of the firing-pin indentation, should not exceed 0.6 mm. [p 254]

3. Disconnect the firing lever (sear) from the ignition harness.

4. Loosen the dog of the dashpot and disconnect it from the bolt assembly case.

5. By pulling on the dashpot, extract the firing pin and arming spring from the bolt assembly case.

6. Clean and examine all parts of the initiator, including:

particular attention to cleaning the chamber of deposits;

certainty that the roller of the firing pin and the release lever rotate freely on their axes;

check the condition of the firing pins, their protrusion beyond the face of the bolt assembly and the absence of [illegible] in the motion

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of the firing pin inside the case of the bolt assembly.

Following the examination, lubricate the internal parts of the bolt assembly with a thin film of lubricant.

7. Assemble the bolt assembly of the initiator and set its firing pin. This is done in the following order:

a) insert the firing pin together with the arming spring into the bolt assembly;

b) align the protruding collars of the dashpot with the corresponding holes in the bolt assembly case and connect them to one another;

v) draw up the lock nut tight which connects the dashpot with [p 255] the bolt assembly case; the grooves on the nut and the case must coincide;

g) draw out the firing pin far enough to bring the trigger beyond the roller where it can drop freely and connect them;

d) safety lock the trigger to the dashpot case by means of MIM-KO.5 wire. The wire should be tight.

8. Connect the trigger with the lanyard of the ignition harness by means of the shaft on which there is a washer, and insert the cotter pin.

9. Insert into the chamber two new cartridges and connect the initiator cases by means of the nut as shown in the section on loading.

10. Safety lock the nut of the initiator by means of KO-KO.8 mm wire.

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CHAPTER VIII [p 256]

/Adjustment-Firing and Sight-Alignment of Armament

1. General Information

Adjustment-firing of the aircraft armament is done:

1. when aircraft are received from the factory or from the repair shop;

2. when indicating or control gear is replaced or repaired;

3. when guns, launching devices, or missile pods are replaced;

4. when there is a replacement of, or a disruption of the adjustment of, the sight;

5. when work is done on the bulletproof glass in front of the sight;

6. when executing orders to do so;

7. when there is doubt in the minds of flight personnel regarding the accuracy of adjustment.

Adjustment checks are made, as a rule, when the aircraft is parked during layover.

2. Sight-Alignment Layout

The layout for sight-alignment (Fig. 60) is designed for the sight-alignment of all types of armament down to a reduced distance equal to D = 35 meters and D = 50 meters.

The cannon, wing racks, sight, and radar antenna are installed in [p 258] the aircraft at an angle of minus 1°30'.

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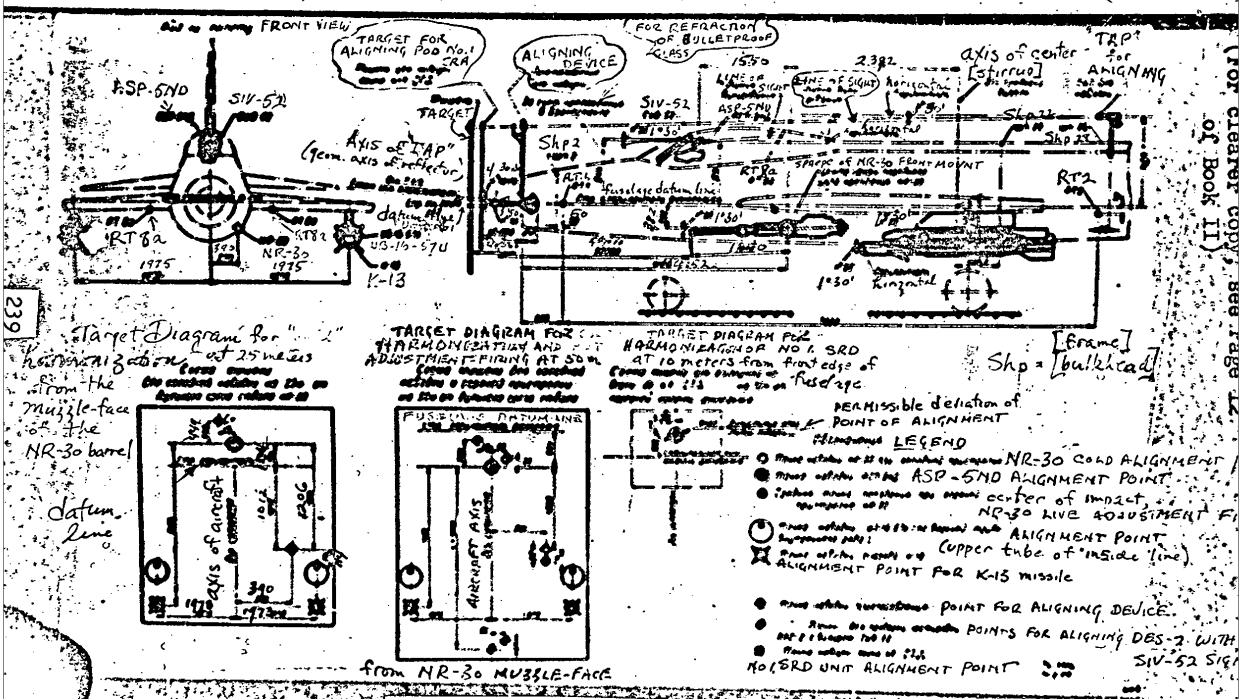
FRONT VIEW
TARGET FOR ALIGNING POD No. 1
ALIGNING DEVICE
FOR REFRACTION OF BULLETPROOF GLASS
ASP-5ND
SIV-52
TARGET
Axis of "AP" (Geom. axis of reflector)
Shp 2
Shp 1
Shp 3
RT 1a
RT 2a
NR-30 1975
K-13
RT 2
Shp = [frame] [bulkhead]
Target Diagram for "1" horizontalization at 25 meters from the muzzle-face of the NR-30 barrel
datum line
axis of aircraft
TARGET DIAGRAM FOR HARMONIZATION AND ADJUSTMENT FIRING AT 50 m
FUSELAGE DATUM LINE
from NR-30 MUZZLE-FACE
TARGET DIAGRAM FOR HARMONIZATION OF No 1 SRD AT 10 meters from front edge of fuselage
PERMISSIBLE DEVIATION OF POINT OF ALIGNMENT
LEGEND
NR-30 COLD ALIGNMENT
ASP-5ND ALIGNMENT POINT
center of impact
NR-30 LIVE ADJUSTMENT FI
ALIGNMENT POINT (upper tube of "inside" line)
ALIGNMENT POINT FOR K-13 missile
POINT FOR ALIGNING DEVICE
POINTS FOR ALIGNING DBS-3 WITH
No 1 SRD UNIT ALIGNMENT POINT
SIV-52 SIG

Fig. 60. Harmonization layout
(For clearer copy, see Page 12 of Book II)

Рис. 60. Схема пристрелки.

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Boresights of the cannon, sight, launching devices and rocket pods correspond to their positions on the aircraft in the horizontal plane.

The aiming point of the sight corresponds to the axis of symmetry of the aircraft. The aiming point of the cannon is 330 mm from the axis of symmetry, and the aiming point of the rocket pods and launching devices is 1,975 mm from the axis of symmetry of the aircraft.

In the vertical plane, the aiming points of the gun (cannon), rocket pods, launching devices and sight are plotted in relation to the fuselage datum line to account for the -1°30' inclination of the cannon and the elevation of the line of sight of the sight to account for the refraction of the bulletproof glass.

On the target, computed for 50 meters, these points are located below the datum line as follows:

a)	for the ASN-5ND	461 mm
b)	for the upper barrel of the inside series of the rocket pod	1,841 mm
v)	for the caliber axis of the APU-13	1,547 mm
g)	for the cannon; according to the TKhP (boresight)	1,737 mm
	for gunfire harmonization	1,749 mm
d)	for aligning (harmonizing) the attachment	16 mm

In relation to the axis of symmetry, the attachment for adjustment firing is pointed 60 mm to the left.

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Alignment of gun camera SSh-45-1-100-OS consists in superimposing [p 259] its optic axis with the central point of the sight.

3. Procedure for Preparing the Aircraft for Target Boresight Harmonization

Checking alignment is carried out, as a rule, on the parking strip with the aid of a boresight harmonization tube at a distance of 25 meters from the line of the booster barrel.

Checking alignment of fire and automatic return fire is done at the target range automatically.

To check alignment of fire at the target range, it is necessary to:

a) raise the aircraft at frames #2 and #28 on safety jacks under the wings so that the bores of the guns are aligned with the shield. Safety jacks should be used as supports only.

If the target range makes it impossible to fire at the shield (because the guns are at a slope), the fuselage nose should be raised so that the gun axis and other points of the layout are set on the shield.

To roll up the fuselage nose to 1°30' it is necessary to set the aircraft so that the point at frame #2 is higher by 877 mm than the point at frame #28;

b) set the attachment for harmonization on the skin of the aircraft at reference points and select a lateral level with the aid of this attachment (Fig. 61); [p 260]

v) set the TKhP (trubka kholodnoy pristrelki [boresight harmonization]) adapter on the fuselage bolts at frame #28 (Figure 62);

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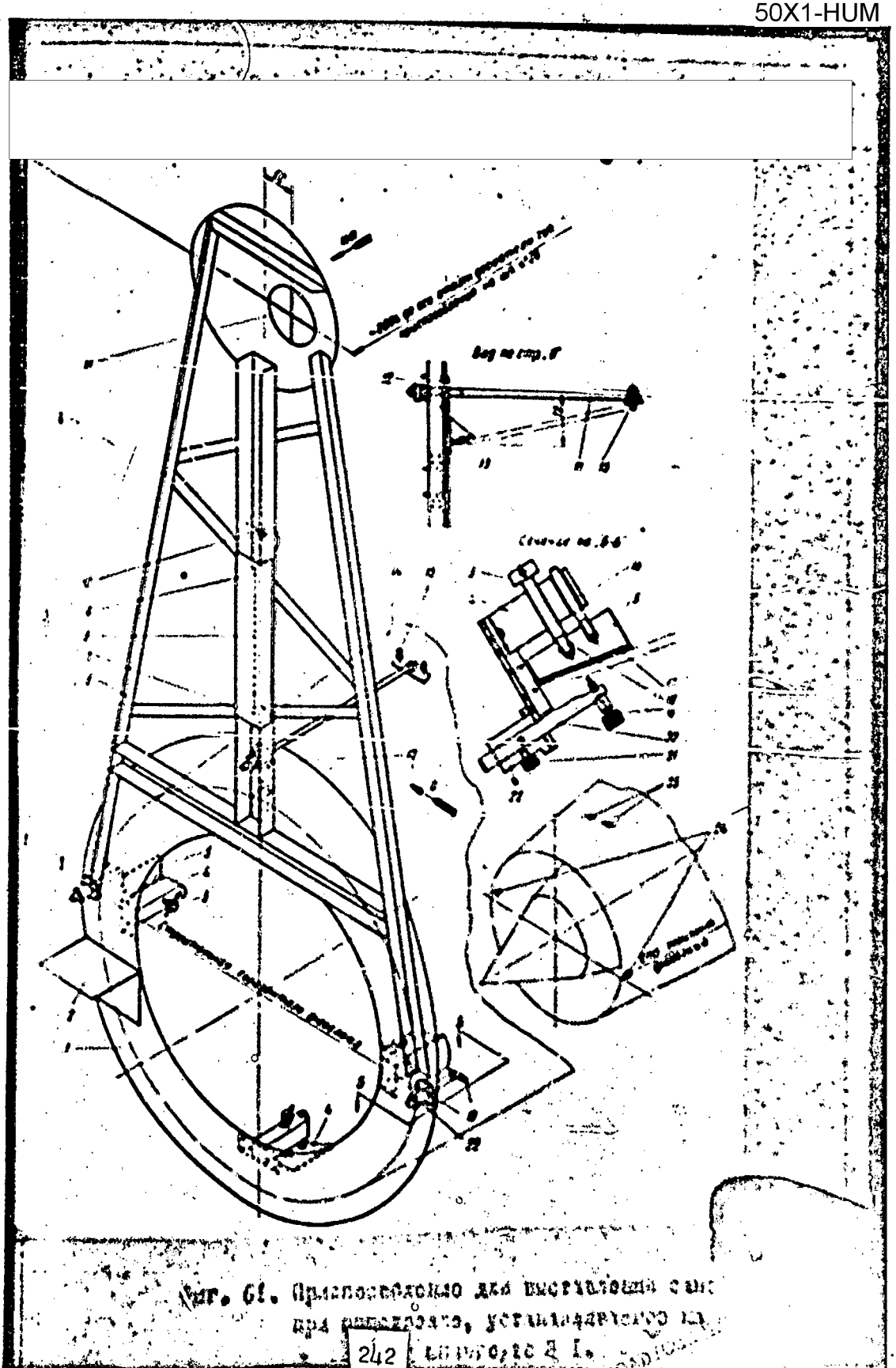

Фиг. 61. Приспособление для выставления самолета при гармонизации, устанавливаемое на шпангоуте № 1.

Fig. 61. Attachment for posting an airplane during harmonization set up at bulkhead number 1.

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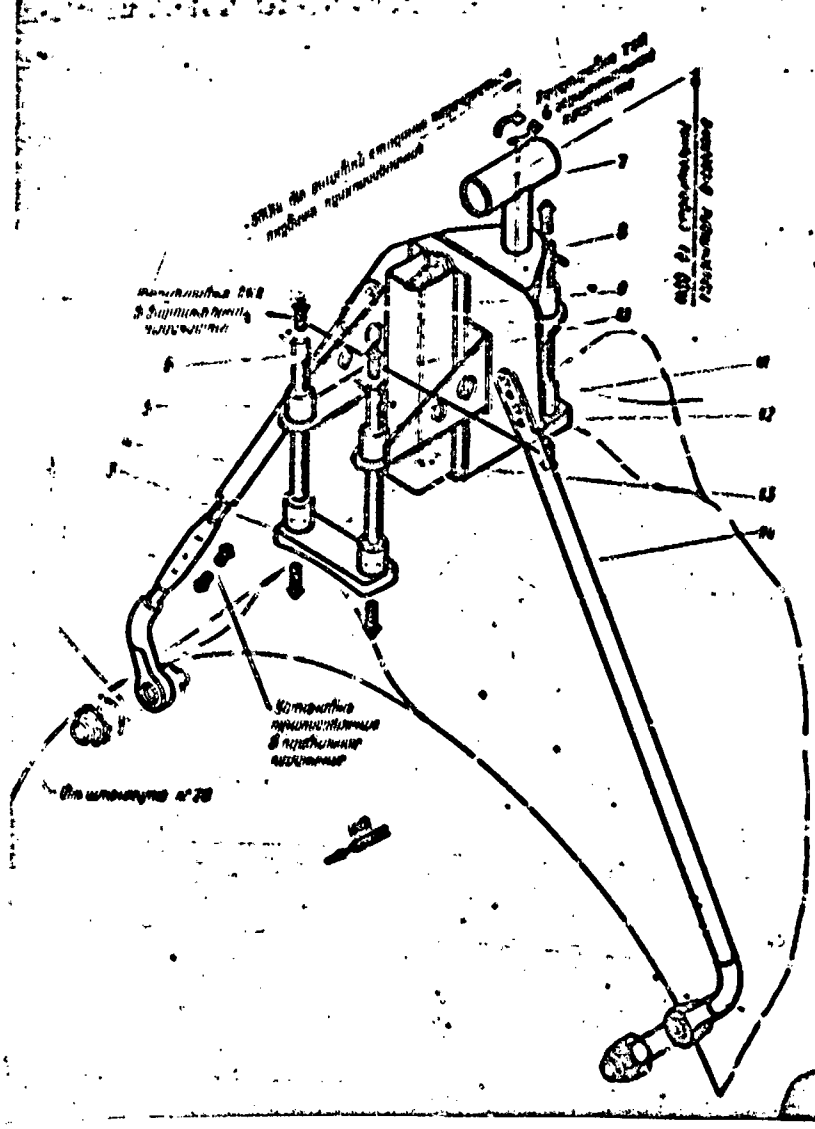

Fig. 62. Attachment for putting airplane in position during harmonization at bulkhead number 28 of the fuselage

Фиг. 62. Приспособление для выставления [illegible] при проверке, установленное на плане [illegible].

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Key to Figure 61. Attachment for Setting Aircraft in Position During Harmonization at Frame #1 [p 262]

1. collar; 2. leveling column; 3. fastening screw; 4. holder; 5. spar; 6. truss; 7. clock hand; 8. pendulum; 9. protective jacket; 10. wire cross (reticle) appliances for gun harmonization apparatus; 12. nut; 13. holder; 14. rod drawbar; 15. lock; 16. directing spar; 17. compact washer; 18. pin; 19. spike; 20. spike holder; 21. clamp; 22. hub; 23. fuselage nut holder; 24. graduated lines on fuselage (I"a" on the leveling diagram)

Key to Figure 62. Attachment for Setting Aircraft in Position During Harmonization at Frame #28 [p 264]

1. joint bolt; 2. clamp; 3. clip; 4. control stand; 5. holder; 6. set screw; 7. holder of gun barrel harmonization apparatus (TKhP); 8. set screw; 9. protective jacket; 10. pendulum; 11. rib; 12. clip; 13. index; 14. control stand

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g) set the TKhP into the adapter and with the adjusting apparatus bridge the reticle of TKhP with the reticle of the adapter located on the skin of the aircraft;

d) set the target at a distance of 50 meters from the dual section of the gun barrel to coincide with the reticle of TKhP attachment at frame #28.

With the absence of a ready-made target for alignment, an ordinary shield is utilized, from which the control point of attachment is transferred to the TKhP. The remainder of the alignment layout is built up around this point.

In the event the attachment is lacking, it is necessary to plot the layout from the shield in relation to the axis of symmetry and datum line of the aircraft, which must be carried over to the shield with the aid of a leveling instrument.

During repair, the longitudinal axis of the aircraft is set up horizontally at fuselage reference points "1" and "2" of the left side at frames #2 and #28.

To secure the horizontal position of the lateral axis, the reference points "9a" of the right and left wing cantilevers should be aligned according to height. [p 265]

The procedure for arranging the aircraft for checking the alignment with the aid of TKhP is analogous.

Before firing from the cannon it is necessary, in addition, to:

a) place chocks (from the front and back) under the main wheels;

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Фиг. 63. Установка защитного кожуха на носовую стойку шасси во время стрельбовых пушек.

Fig. 63. The arrangement of the protective covering on the nose landing gear strut while testing the cannon.

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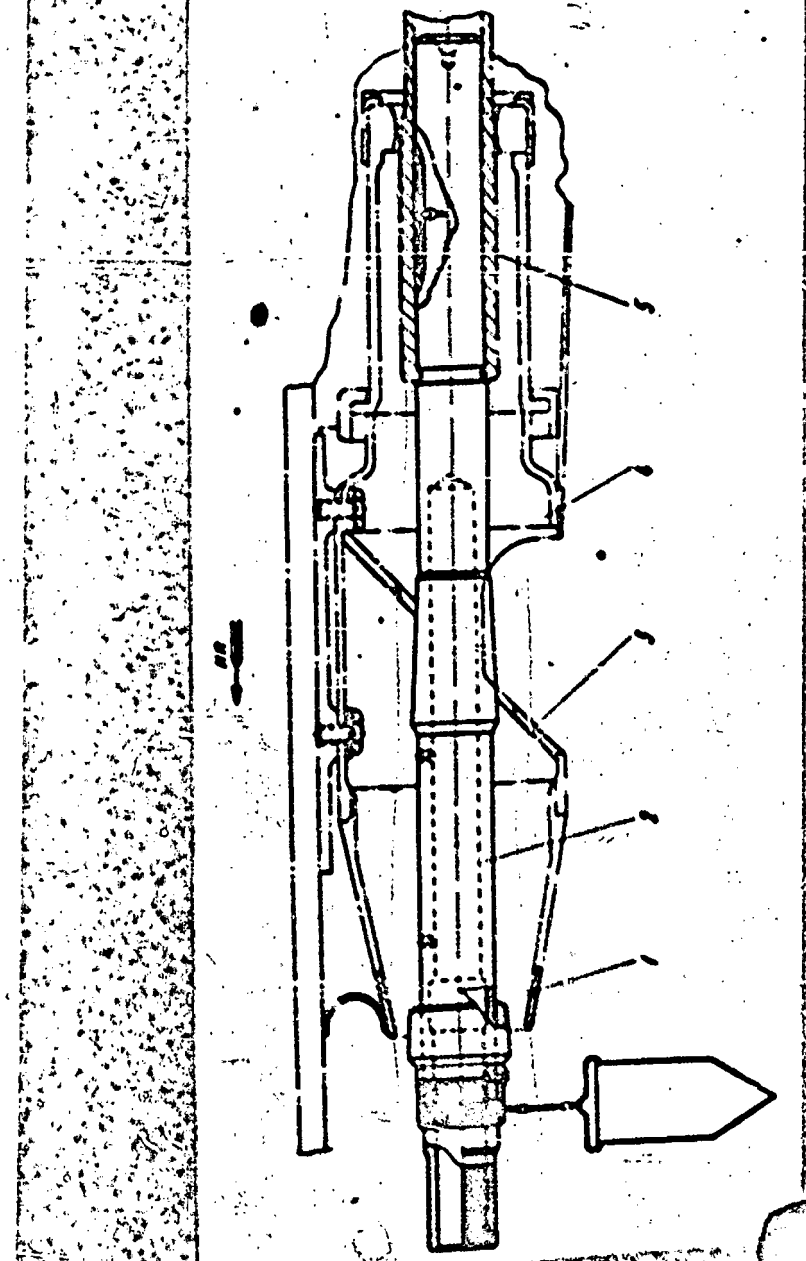

Рис. 64. Приспособление для проверки исправности действия предохранительного конуса. 1 – корпус компенсатора; 2 – дульный тормоз; 3 – отражатель; 4 – газовая камера; 5 – ствол.

Fig. 64. Device for Checking the Firing Safety Cone 1. body of compensator; 2. device; 3. deflector; 4. gas compensator; 5. barrel

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b) cover the nose strut with a covering to protect it from powder gases (Fig. 63);

v) check the safety of firing through the gas compensator with the safety cone (Fig. 64);

g) remove the shield from the landing gear strut;

d) remove the cover from the air intake;

ye) place the PVD-5 rod in the uppermost position and remove the hood from it;

zh) place a red flag (pole, 1.5 m; flag size, 0.25 X 0.40 m) at the firing range in the most visible spot;

z) place a red flag 4 m from the aircraft in front of the cannon barrel and make sure that no one crosses into the danger zone.

WARNING: 1. The cannon should be unloaded while the target hits are being marked.

2. The command "Fire" is given only by the adjustment leader.

3. Fire only when the cannon mounting hatches are open, the barrel fairing is removed, the brake shields are open, and the cockpit light is out. Firing and cooling of the cannon should be done according to the instructions for operation of the cannon. [p 268]

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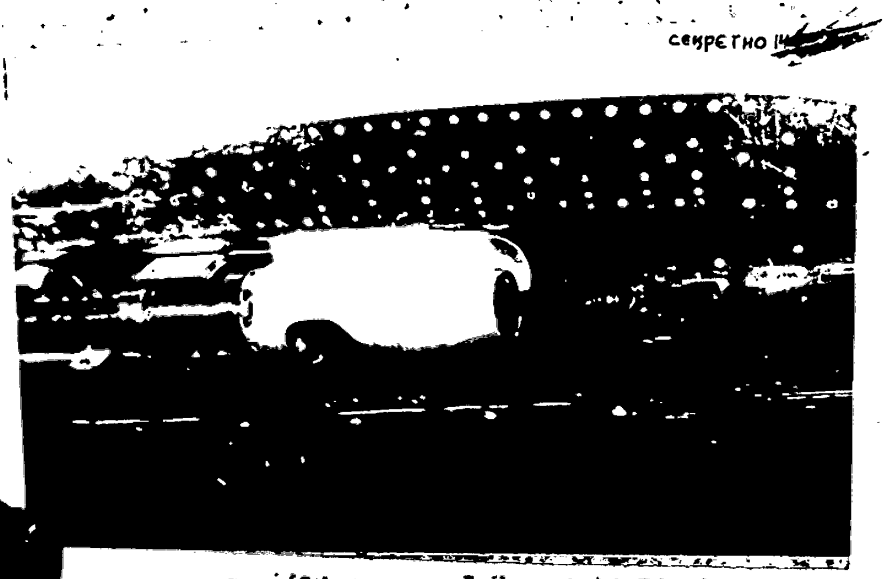

Fig. 65. The arrangement of the TKhP in the cannon barrel.

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4. Procedure for Adjusting and Aiming the Cannon

1. Arrange the aircraft and target for checking the adjustment.

2. Using the boresight method, make sure that the gun bore is aimed at the bore-sighting point of the target. If necessary, aim it. It must be remembered that the cannon is fixed and as a rule is not aimed.

Aim the cannon only after it has been established that the device and the sight are exactly aligned with the corresponding points on the target.

3. Remove the TKhP from the cannon barrel (Fig. 65).

4. Fire four single rounds and find the center mark of the hits.

WARNING: Before firing make sure that the TKhP is not in the cannon barrel.

The adjustment is considered correct if the central point of impact of the cannon fire does not go beyond the limits of a firing circle (on the target) having a diameter of 100 mm.

When necessary, the cannon may also be adjusted by repeated firing of single shots until the central point of impact falls within the firing circle on the target. [p 270]

The construction of the rear and front cannon mountings, the barrel mountings, and the gas compensator provide adjustment of the installation in the horizontal and vertical planes.

The cannon is adjusted with the aid of the rear mounting in the following manner:

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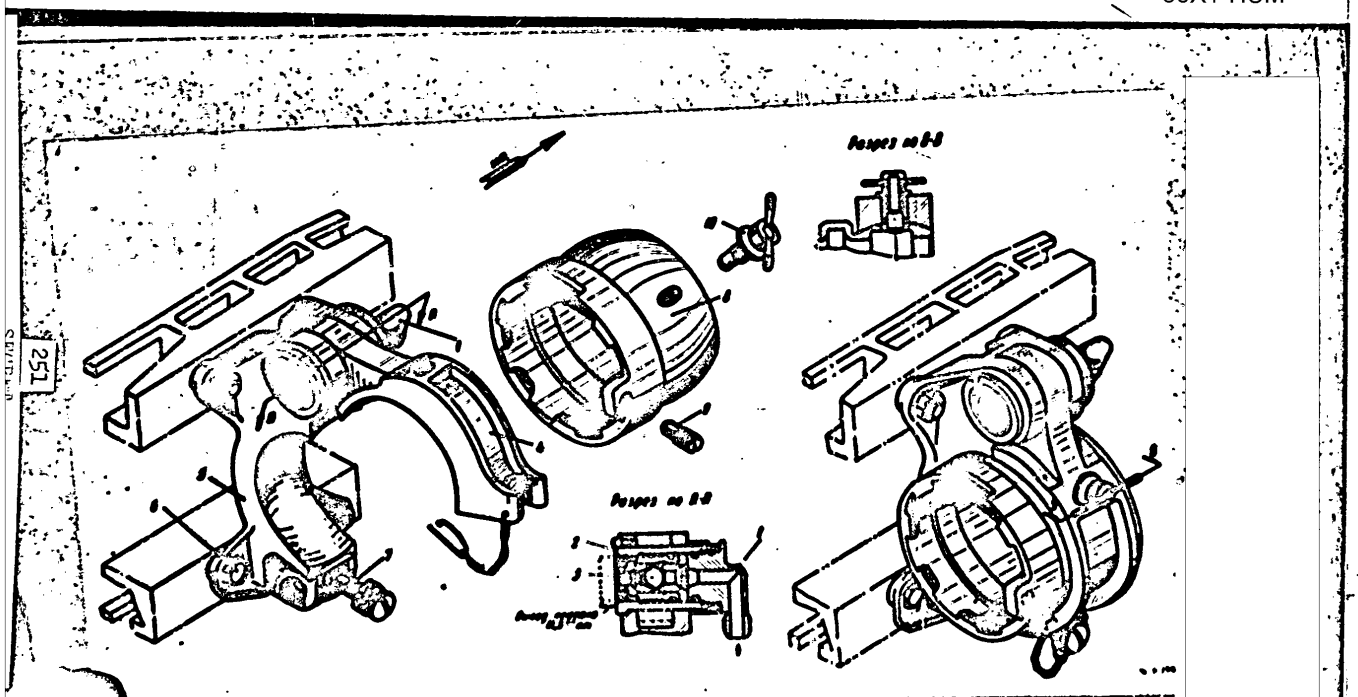

Fig. 66. Forward cannon mounting.

Рис. 66. Передний узел крепления пушки.

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Fig. 66. Forward Cannon Mounting [p 272]

1. connector for air check; 2. body of valve; 3. reverse valve; 4. swung portion of collar; 5. upper portion of collar; 6. mounting bolts; 7. tightening bolt with nut; 8. tightening rings; 9. stopper for mounting ring to cannon; 10. stopper for mounting ring to collar.

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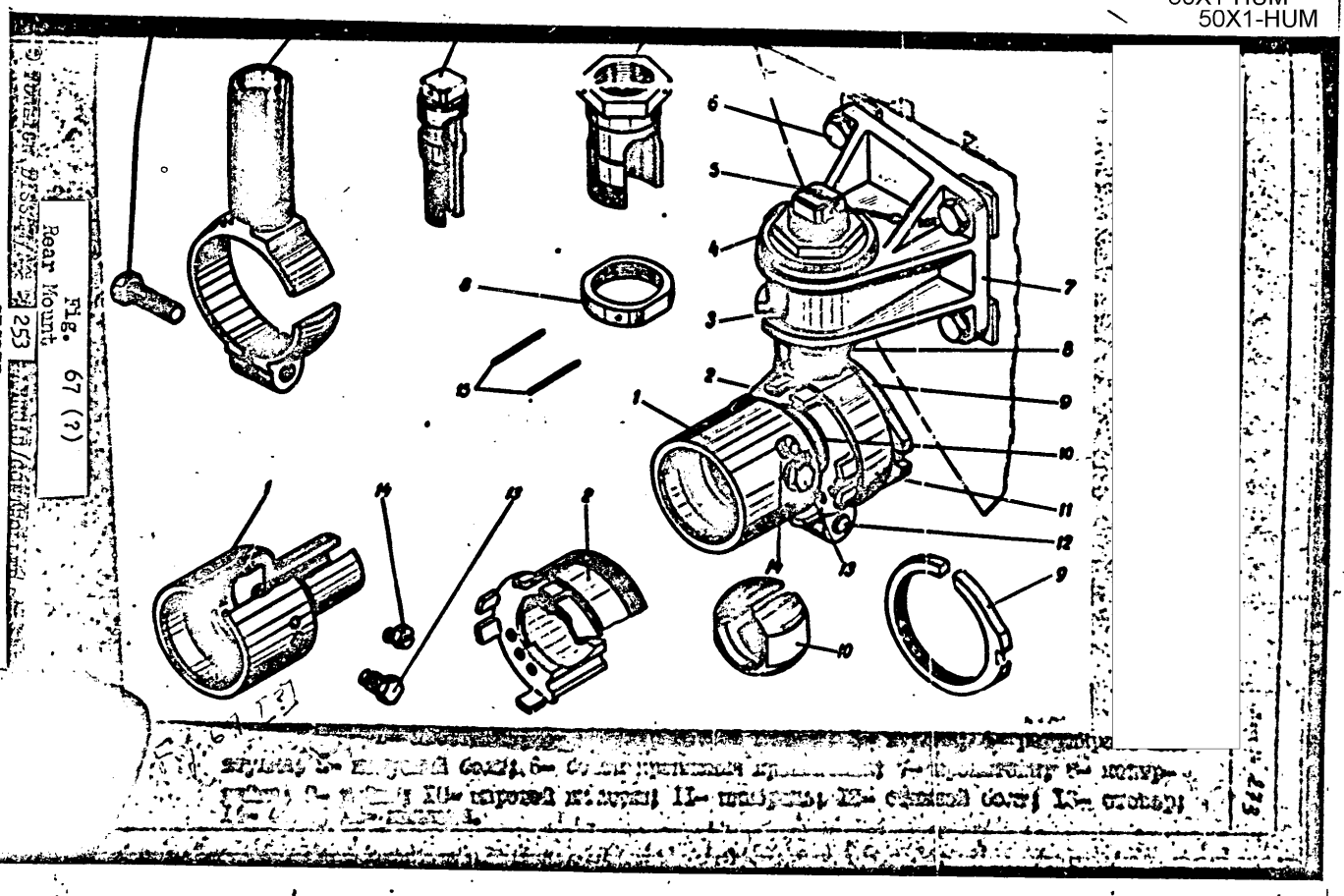

Fig. 67 (?)
Rear Mount

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a) loosen the collar on the front mount by half a turn on the nut (Fig. 66);

b) remove the safety wire and seal on the rear mount (Fig. 67);

v) loosen the fastening nuts on the barrel stop;

g) remove the seal from the hinged bolt on the gas compensator cup, swing the hinged bolt out, lift the eccentric rings from the cup and move them toward the barrel;

d) to adjust in the vertical plane, it is necessary to loosen the upper conical tightening bolt and rotate the bushing on the rear mounting with a wrench until the axis of the cannon barrel coincides with the harmonization point of the cannon;

ye) to adjust the cannon in the horizontal plane, it is first necessary to loosen the tightening bolt on the eccentric bushing of the rear [p 274] mounting and rotate this bushing with a special wrench until the axis of the cannon barrel coincides with the aiming point on the target.

Adjustment should first be done in the horizontal plane and then in the vertical, since rotation of the eccentric bushing in the vertical plane may cause damage.

After adjustment, the following is required:

a) retighten and secure with safety wire the collar on the forward mount (Fig. 68);

b) retighten, secure with safety wire, and reseal the eccentrics and conical bolts on the rear mount;

v) tighten the nuts on the barrel stops, first setting the collars so that the space between the collar and the barrel is uniform all the

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way around;

g) replace the eccentric rings in the gas compensator cup without allowing contact between the barrel and the bushing, tighten the nut, and secure with safety wire and reseal (Fig. 69).

The minimum clearance between the barrel and the eccentric rings of the gas compensator should not be less than 0.5 mm;

d) check the safety of firing through the gas compensator with the safety bushing. Contact of the bushing with the gas compensator baffle is not permitted.

[Note: page 275 was missing from original text]

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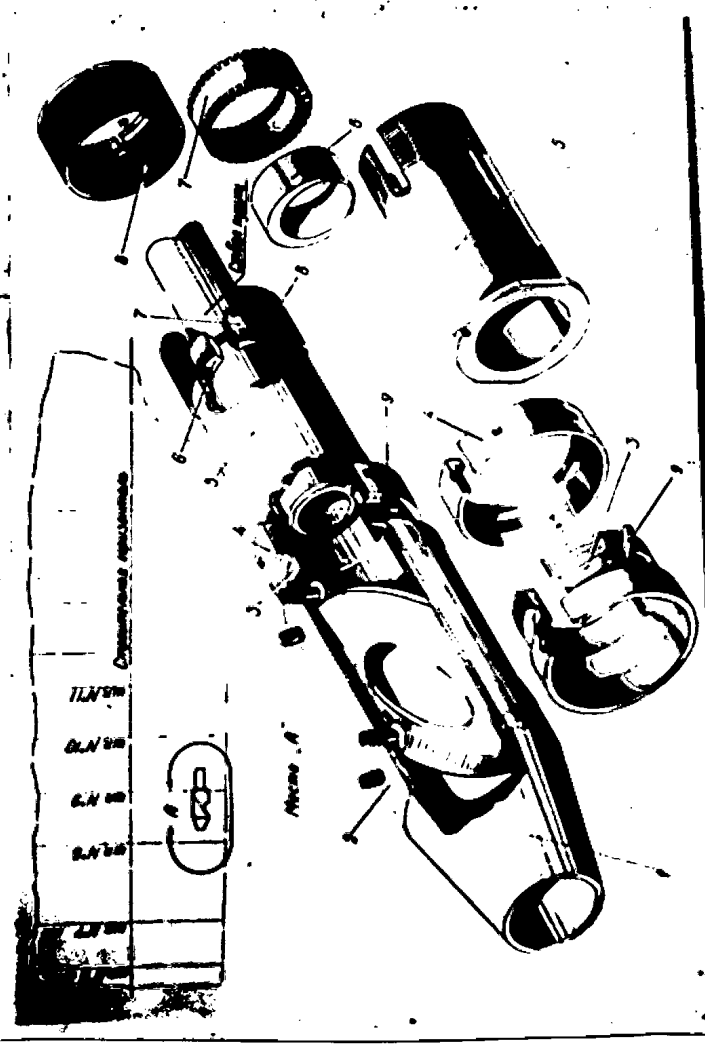

Fig. 69. Gas Compensator

1. cone of compensator; 2. body of compensator; 3. sleeve; 4. nut; 5. bushing; 6. inner ring; 7. outer ring; 8. sleeve nut; 9. seal with spring

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5. Sighting and Regulating the UB-16-57U Pods [p 278]

In sight adjustment of the suspensions of the rocket armament on the aircraft, the accuracy of the setting is checked first, and, if necessary, the adjustment of the rocket pods UB-16-57U is checked.

The sight adjustment is checked with the aid of the TKhP with adapters in the upper chamber of the inner row of the UB-16-57U pod.

Adjustment of the pod is considered correct if the cross hairs of the TKhP do not extend beyond a circle with a diameter of 100 mm at a distance of D = 50 m.

If this requirement is not met, it is necessary to adjust the pods.

To adjust the pods it is necessary to:

1. Open the access hatch for the bushing of the forward holder packing and unscrew the lock nut.

2. By rotating the bushing of the forward assembly with a wrench, set the pod on a vertical plane.

3. Tighten the lock nut of the regulating bushing and close the hatch.

WARNING: In adjusting the launching assemblies on a vertical plane, it is necessary to slacken somewhat the grip of the bands. After regulating, tighten the bands again with a torsion wrench and check the setting.

4. By rotating the adjusting bolt on the rear fastening, superimpose the cross hairs of the TKhP precisely on the target to align the rocket pod horizontally. [p 279]

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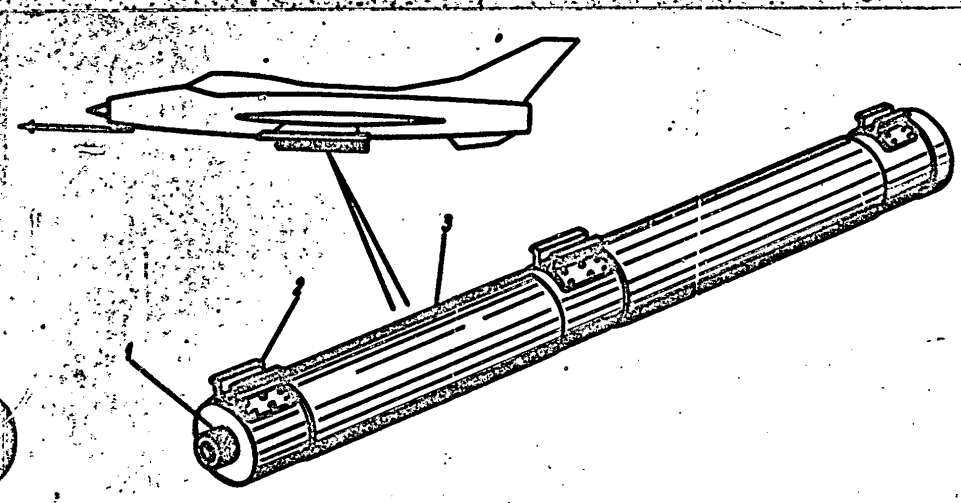

Fig. 70. Apparatus for sight harmonization (TKhP-13)
1-bushing; 2-guide; 3-housing.

Фиг. 70 Приспособление для наводки (ТХП-13).
1-втулка; 2-направляющая; 3-корпус.

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5. Be certain that during sight adjustment the aircraft remains stationary.

6. Sighting and Adjusting the APU-13

Sight adjustment of the APU-13 is done with the sight harmonization tube which is used to check the sighting of the rocket pods.

The tube is inserted in the adapter TKhP-13 (Fig. 70) which is mounted in the launching assembly. In doing this, the axis of the adapter should correspond with the axis of the suspended rocket.

Before suspending the APU-13, the forward and rear supports of the wing pylon must be replaced and fastened to the launching assembly support with a base of 60 mm (forward) and 62 mm (rear).

In this case, the APU-13 is usually not adjusted because the launchers are attached to the aircraft without disturbing the adjustment of the UB-16-57U pod and meet the requirements for sighting accuracy.

The sight adjustment of the APU-13 is considered accurate if the [p 281] cross hairs of the TKhP at a distance of 50 meters do not extend beyond a circle with a diameter of 350 mm.

Thus, adjustment of the APU-13 consists merely of checking the fulfillment of this requirement.

If the cross hairs of the TKhP still extend beyond the control circle, it will be necessary to make adjustment as in setting the rocket pods.

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7. Sighting and Adjusting the ASP-5ND

The accuracy of laying in the sight is checked immediately after plotting on the panel the outline of the target. This is done so that in the future, dislodging of the aircraft may be controlled while firing other types of armaments.

To check the accuracy of laying in the sight, it is necessary to:

a) turn on the circuit breaker marked "Sight, Sight Warm-Up" and the circuit breaker "Sight;"

b) set the handle of the arrester in the position "Gyro;" set the switch lever to "NR-30," and the dial of the computer unit to "0.80."

v) check the matching of the central point of the sight coordinate with the corresponding point on the target. If necessary, adjust the sight.

The sight is layed in by turning the housing of the sight head in relation to the sight bracket. [p 282]

For this it is necessary to:

a) loosen two vertical bolts which fasten the intermediate bracket to the sight bracket;

b) move the sight head with the intermediate bracket through the necessary angle and tighten the bolts;

v) confirm the accuracy of the setting;

g) place a red graduation line on the intermediate bracket in accordance with the graduation line on the sight bracket;

d) turn off the circuit breaker of the sight.

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8. Sighting and Regulating the SIV-52

If there is an SIV-52 on the aircraft, it is layed in and regulated as follows:

1. Remove the small cap from the lens of the viewer.

2. Loosen the collar nut for fastening the sight and, with the SIV-52 apparatus turned on, turn the viewer on the collar so that the central point of the sight coordinate is visible approximately in the center of the visual field of the device, and then tighten the collar nut.

3. Place the small cap on the lens of the viewer and turn off the SIV-52.

The procedure for checking the adjustment of the OZS-2 is outlined in the instructions on the SIV-52.

9. Sighting and Regulating the SSh-45-1-100-OS Photographic Control Device

[p 283]

The spherical coupling on the fastening bracket of the gun camera permits the device to be moved while laying in. The laying in is done with the spotting cassette and consists in adjusting the center of the cross hairs in the spotting cassette to the central point of the sight.

In checking the adjustment, it is necessary to:

1. Turn on the switch "Battery Ship, Airfield" and the circuit breakers marked "Sight Warm-Up" and "Sight."

2. Set the switch lever on the sight to "NR-30," the computer

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dial to "0.80," and the arrester knob to "Gyro."

3. Regulate the brightness of the sight.

4. Insert the spotting cassette in the gun camera and adjust the sharpness of the ocular.

5. Place the baffle plate of the gun camera against the objective, look into the eyepiece, and turn the spotting cassette with a wrench.

In order to avoid kinematic distortion when the baffle plate is shifted with the wrench, the latter must be turned and advanced inside the device using slight force.

6. Be certain that the cross hairs of the gun camera coincide with the central point of the sight. [p 284]

7. If the gun camera does not coincide with the central point of the sight, adjust the gun camera.

To adjust it, it is necessary to:

a) loosen the fastening bolts of the gun camera on the bracket;

b) looking into the eyepiece of the spotting cassette and turning the [word illegible] cover plate in relation to the [word illegible] nut of the bracket, superimpose the cross hairs of the gun camera on the central point of the sight;

v) tighten the fastening bolts of the gun camera on the bracket and be sure in doing this that the adjustment is not disturbed.

8. Turn off the sight and battery.

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CHAPTER IX [p 285]

ROUTINE MAINTENANCE

1. General Procedures

Routine maintenance on aviation armament is carried out simultaneously with routine maintenance on the aircraft, the engine, and the special equipment at regular time intervals according to the flight time of the aircraft and the calendar period of its operation and storage.

When armament aggregates are replaced, routine maintenance, as determined by the calendar period for storing them, must be conducted if they are installed on the aircraft.

In accordance with the flight time, routine maintenance is carried out after every 50±5 and 100±10 hours.

Maintenance according to the calendar period of operation which is independent of flight time is conducted after every 7±3 days, one month±5 days, and 3 months±10 days of operation of the aircraft.

In the 100-hour routine maintenance, the 50-hour routine maintenance is also conducted; in conducting monthly maintenance, the 7-day maintenance is included; and in conducting maintenance after every 3 months, the 7-day and monthly maintenance are also included.

For grounded aircraft, maintenance is conducted after every 10±2 days, 30±6 days, and 3 months±10 days of storage.

To ensure trouble-free operation of the armament under special conditions of the base (humidity, dust, etc.), in cases of the extensive

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use of individual assemblies, in fulfilling special assignments, or also during long/interruptions in flight operations, the armament engineer of the unit orders special maintenance on all or some aircraft. [p 286]

Before beginning the 50-hour and 100-hour routine maintenance, it is necessary to do the preliminary work and unload the RO pods, the firing mechanisms of the seat, the charge-driven piston mechanism for jettisoning the canopy, and the charge-driven piston mechanism for jettisoning the drop tank.

An entry in the service list of the aircraft provides information on fulfillment of routine maintenance for armaments.

Maintenance According to Calendar Schedule of Operation Irrespective of Flight Time of the Aircraft

(mark + denotes work to be performed)

No	Work to be performed	After every 7 ± 3 days	30 ± 5 days	3 months ± 10 days
1	2	3	4	5
1	Visual inspection of pylons, RO pods, and launch mechanisms for dirt and damage	-	+	+
2	Clean and lubricate pods with partial dismantling and removal from their mountings	-	+	+
3	Check settings of RO pods or the launchers	-	-	+
NOTE:	Alignment of RO and APU are checked if they were used or suspended on pylons after long storage in warehouses			
4	Check fastening assemblies of the units of pneumatic system and flexible hoses and be sure there are no breaks in tubing			+

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1	2	3	4	5
5	Check cartridges and links in fire unit and, if necessary, clean and lubricate them. The cartridges should not have corrosion, dents, or breaks on their cases or longitudinal looseness and free rotation of shells in their cases; links should not be broken		+	+
6	Check externally the assemblies of sight, SIV-52 viewer, and gun camera and make certain there are no mechanical defects and that mountings and fastenings are secure and correct	+	+	+
7	Check and examine braces of sight assemblies, condition of connecting cables, and reliability of metallic coating of assemblies and cables in relation to body of aircraft	-	+	+
8	Clean and lubricate moving parts which drive launching mechanisms. Clean ignition contacts	-	+	+
9	Check external condition, security of fastenings, and shock absorbers of VRD computer and DVS-5 sensor	-	+	+
10	Check security of sub-coupling of rubber canvas hoses of the static system to VRD and DVS-5 connecting pipes	-	+	+
11	Make outside check on exactness and security of fastening of P-5 temperature receiver	-	+	+
	Photographic Monitoring Devices			
12	Examine photo monitoring devices and check: -security of fastening of lens and [2 words illegible] to body, and accuracy of optic parts -ease of turning spool mechanisms of photo devices -condition of velvet linings of cassettes which protect the film from exposure -efficiency of photographic monitoring devices with current on	-	+	+

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1	2	3	4	5
13	Check setting of photographic monitoring device	-	+	+
	Viewer SIV-52			
14	Check accuracy of adjustment of OZS with sight	-	-	+
15	Check tightness of bolts on mounting panel of power pack	-	-	+

Work Performed After Every 6 Months of Operation of Aircraft

16. Dismantle, clean, examine piece by piece, and lubricate the firing mechanisms of the ejection seat and test them with blank cartridges. Routine maintenance on the firing mechanisms is combined with maintenance on the seat.

Work Performed After Every 12 Months of Operation

17. Disassemble the firing mechanisms of the canopy emergency jettison and the drop tank; clean their parts, examine and lubricate. Fire the mechanisms with blank cartridges.

Maintenance According to the Flight Time of the Aircraft [p 289]

No	Work to be performed	Periods for fulfilling work according to flight time of aircraft after each:	
		50±5 hours	100±10 hours
1	2	3	4
	On Weapon Mountings		
1	Carefully examine assemblies for fastening weapons, gas compensators, gas exhausts, power levers, and spent shell ejectors		

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1	2	3	4
	Check the condition and evenness of the joints of the feed tract	+	+
2	Check safety of firing through gas compensator with help of safety cone. The cone is not permitted to make contact with the mount of the compensator	+	+
3	Examine with a magnifying glass the fastenings for the weapons	+	+
	Weapons		
4	Lay in the weapon with the help of a TKhP boresight harmonization tube	+	+
5	Clean and examine the weapon with complete dismantling in accordance with technical description. Clean contacts and check the operating reliability of electric triggers		

NOTE: Cleaning and examining with complete dismantling are also carried out when the weapon is taken out of grease packing, when there are systematic malfunctions, and after a specific firing.

6	Adjust the weapon by firing	-	+

NOTE: Adjustment is also made when the aircraft is received from the plant, after repair or replacement of the weapon, and also when the pilot has doubt concerning the correctness of the adjustment.

7 Check the sight with the KP5SND apparatus: [p 290]

a) accuracy of electrical circuits of the sight:

-the d-c voltage of 27 v ± 10%;

-current for warming optics of sight head;

-current for warming main gyroscope and null gyroscope;

-the a-c voltage of 115 v ± 5% with frequency of 400 cps ± 5%;

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1 | 2 | 3 | 4

-the d-c reference voltage of 260 v;

-the stabilized d-c voltage of 22 ± 0.3 v;

b) the air tightness of the altitude mechanism and operation of NNP with switch set at position "N" ("N-DUAS");

v) the range accuracy according to dial "D" of the computer with aid of range-only radar simulator;

g) the accuracy for computing time by the sight according to dial "T" of computer depending on range, altitude, and ballistics of the weapon;

d) the accuracy of plotting sighting for the artillery piece, total corrections for sighting, and slippage in the plane of symmetry of the aircraft for the RS (rockets);

ye) the accuracy of plotting range rings;

zh) the current in control coil (90 ÷ 100 ma);

z) the zero current in horizontal channel of NG (not more than 6 ma -- this value includes current component of sight angle);

k) control of main gyroscope by currents in correction coils of horizontal channel;

l) precession time of main gyroscope (must be at least 30 seconds); [p 291]

m) check correction on slippage in plane of symmetry and planes of wings with aid of the KP5ND which has simulator "DUAS."

NOTE: To measure vertical angles of 5 degrees, the start of the reading (the cross hairs in the field of vision of telescope KP5S-2) should be shifted downward by 5 degrees, thereby making it possible to measure angles on the order of 10 degrees.

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1	2	3	4
	n) check time constant for filter. The time constant in the DUAS-P18 circuit must equal $4.8 \pm \frac{0.8}{0.2}$ seconds.	+	+
8	Examine condition of electric wiring and soldering of wires to arms of potentiometer for manual range introduction P12	-	+
9	Check accuracy of correction coils Kkg and Kkv of gyroscope of sight head by measuring resistance between 7,8 and 9,10 with the pivot pins PG-1. Resistance in both cases should be 400 ohms ± 10%	-	+
10	Clean, examine, and blow out with compressed air the commutators of electric motors DG-4M and DG-6. Examine brushes with cables and the contacts of the centrifugal regulator for the absence of solder. Measure height of brushes and, if necessary, replace them and grind the commutator and seating. Height of the brushes must be at least 4 mm without springs and at least 15 mm with springs	-	+
11	Examine condition of gear teeth of the sight head, paying special attention to the bronze spur gears and the screw connection gears. Lubricate with OKB-I22-7 lubricant	-	+
12	Check freedom from swelling of cork rings of reversing clutches 2RT-200 and R-200 (the gap between the cork rings of the armature and the gears must be at least 0.05 mm)	-	+
13	Lubricate the central bearing and bearings of the universal joint of the sight head gyroscope with OKB-I22-5 lubricant and check the precession time	-	+
14	Check the condition of the optic parts of the sight and wash them with distilled alcohol	-	+

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1	2	3	4
15	Lubricate the main bearing and bearings of the universal joint of the null gyroscope with OKB-I22-5 lubricant	-	+
16	Clean, examine, and blow out with compressed air the commutator of electric motor DR-3.5m and examine the brushes for scorching. Measure height of brushes and, if necessary, replace them and grind the commutator and seating. The height of the brushes must be at least 3 mm	-	+
17	Examine the terminal switches of computer assemblies "D" and "T"	-	+
	Photographic Monitoring Devices		
18	Disassemble photo monitoring device SSh-45 so that the main parts can be cleaned and blown out with compressed air. When necessary, wash moving parts with gasoline and lubricate in accordance with description	-	+
19	Clean and blow out with compressed air the commutators of the electric motors. Check the condition of the brushes and measure their height. Minimum height of the brushes for the SSh-45 is 4.5 mm	-	+
	The SIV-52 Viewer		[p 293]
20	Clean the surfaces of the insulators for all high-voltage leads and measure the voltage at the output of the power supply to SIV-52	+	+
21	Measure the threshold sensitivity of the SIV-52 viewer	+	+
	Pylons for the RO Pods and Drop Fuel Tank		
22	Remove wing pylons from aircraft. Remove locks from them and from pylons of drop tank. Wash with gasoline containing 3-5% TsIATIM-201 and examine for damage. Clean wing pylons and oil moving parts without fail	+	+

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1	2	3	4
23	Release lock mechanically and be sure that parts are in working order and that spring operates reliably. Check minimum voltage to disengage lock actuator of pylon (must be not more than 20 v). Set the locks on the pylons and pylons on the aircraft. Secure fastenings of pylons to wing. Close hatches on surfaces of wing	+	+
24	Check operation of locks from emergency jettison button. Check operation of AOS system. With the aid of the control apparatus, check fire control device	+	+
25	Examine power units of the pylon attachments using a magnifying glass	+	+
	RO Pods and Launch Mechanisms		
26	Check alignment of RO pods or launch assemblies	+	+
NOTE:	Check alignment of RO pods and launch assemblies when used or suspended on the pylons after a long period of storage in the warehouse.		
27	Examine power units of RO pods and launch assemblies with a magnifying glass	+	+
28	Clean the contact seats under the ignition plugs of the rockets, completely dismantling them if at least 20 rounds have been fired in the barrel of the RO pod	-	+
29	Completely dismantle, clean, examine, and lubricate the RO pods and then reassemble	-	+
30	Check operation of locks using emergency jettison button and operation of the servomechanisms	+	+
31	Check alignment of launch mechanisms	+	+
32	Measure forces required to open clamps and move parts in launch mechanisms	+ (as well as after 10 uses)	+

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1	2	3	4
33	Check working order of power, start, and control circuits	+	+
	On the Overload Indicator MP-28A		
34	Remove indicator, wipe it with a clean, dry cloth, and examine it for defects. Check the conformity of its readings with the rating-plate data. Check the degree of signalling of overload at P = 2 and p = 1.6. Set the indicator in the aircraft (to be done by specialists on these devices).	+	+
	On Altitude Indicator VS-14500		
35	Remove altitude indicator, wipe it with a clean, dry cloth, and examine it for defects. Check air tightness of static measure and accuracy of disengagement of contact. Set altitude indicator in aircraft (to be done by specialists on these devices).	+	+
	On Air Speed Indicator DVS-5		
36	Remove indicator from aircraft, wipe it with clean, dry cloth, and check for mechanical defects. Check working order of shock mount. Check accuracy of the voltage output of DVS-5. Set indicator in aircraft	+	+
	On the VRD Computer		
37	Remove computer from aircraft, wipe it with clean, dry cloth, and examine for mechanical defects. Check working order of shock mounts. Set computer in aircraft	+	+
38	Check accuracy of VRD computer when operating with DVS-5 indicator, P-5 receiver, and range-only radar	+	+
39	Check union of range-only radar with VRD computer, DVS-5 indicator, and P-5 receiver	-	+

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1	2	3	4
	Aggregates of Pneumatic System		
40	Examine and check on the bench the tightness, minimum voltage, and current during disengagement of EK-48 valves. Check condition of pneumatic system piping	+	+
	Firing Mechanisms		
	WARNING: Before working on the firing mechanisms, be sure that they are unloaded.		
41	Disassemble, clean, examine in detail, and lubricate the firing mechanisms of the ejection seat, and fire them with blank cartridges	+	+
42	Dismantle the firing mechanisms of the canopy emergency jettison and the drop tank, clean their parts, and examine and lubricate them. Fire the mechanisms with blank cartridges	-	+
43	Check the presence and condition of the ZIP pods for the weapons, the pylons, the RO pods, the mountings, the sight, the cassette, and the photographic monitoring devices. Repack the ZIP	-	+

[p 296]

Maintenance According to Calendar

Schedule of Aircraft in Storage

After every 10 ± 2 days

1. Examine and clean launch mechanisms.

2. Check operation of the armament aggregates in the preflight preparation.

3. Clean the cannons.

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After every 30 ± 5 days

3. [sic] Perform a postflight examination.

4. Examine the magnesium alloy parts and, if necessary, restore the paint and lacquer coatings.

After every 3 months ± 10 days

5. Measure the threshold sensitivity of the SIV-52 viewer.

After every year

6. Examine the presence of the ZIP on the pylons and the launch mechanisms and repack.

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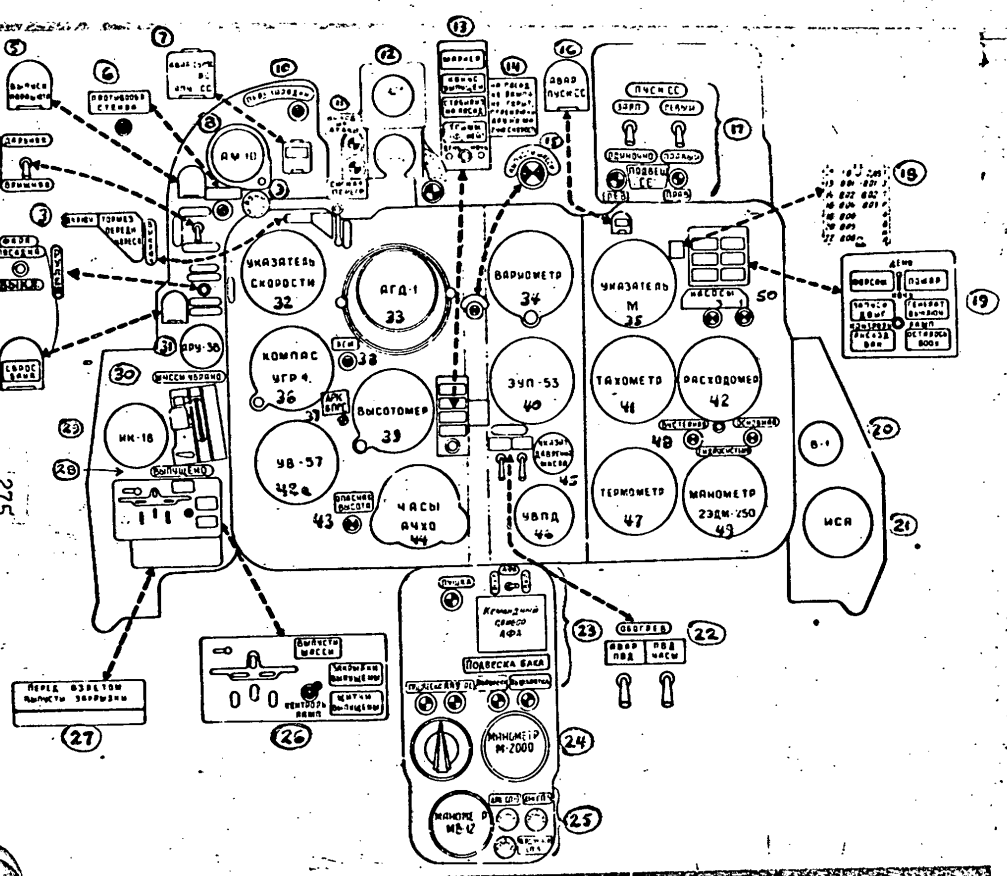

Фиг. 71. Приборная доска.

Figure 71. Instrument Panel

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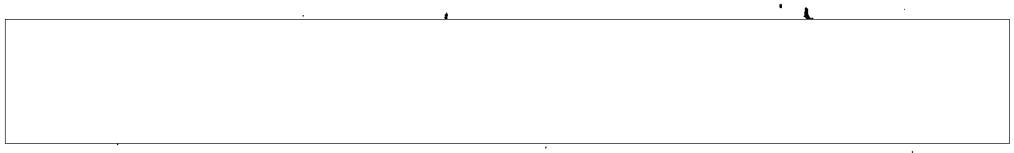

Figure 71. Instrument Panel

(Key)

(1) Tank jettison

(2) Lights / Landing / Off — Taxi

(3) On — Nose wheel brake — Off

(4) Homing — Long range / Short range

(5) Parachute release

(6) Glass de-icer

(7) Emergency jettison of rockets, APU, missiles

(8) AM 10 accelerometer

(9) Emergency brake

(10) Reload

(11) Withdraw from attack ; Overload signal

(12) UD-1 range indicator

(13)

Marker
Cone extended
Stabilizer - landing
Trim effect neutral

Day Night

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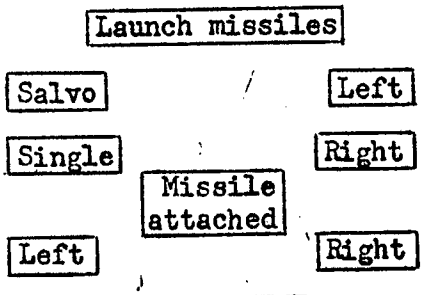
(14) Light is not on during landing. Turn ARU (Avtomaticheskaya regulirovka upravleniya ?)-- Automatic controller, to low speed

(15) Extend landing gear

(16) Emergency launch of missiles

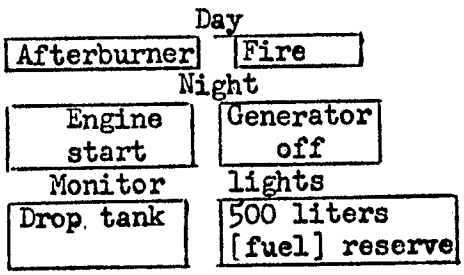
(17)



(18)

-	1.8	2.05	C
13	0.01	0.01	o
14	0.02	0.02	r
16	0.04	0.03	r
18	0.06		e
20	0.05		c
22	0.08		t
			i
			o
			n

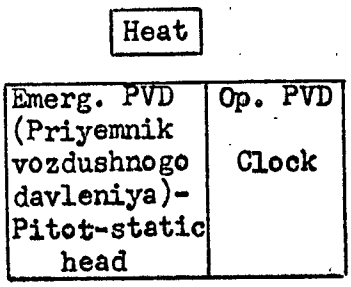
(19)



(20) V-1 voltmeter

(21) ISA (Integriruyushchiy schetchik amper-chasov) -- Ampere-hour meter

(22)



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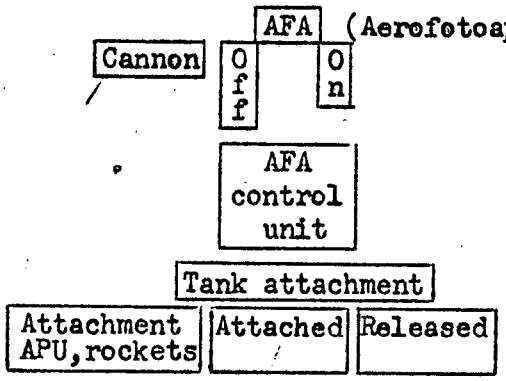
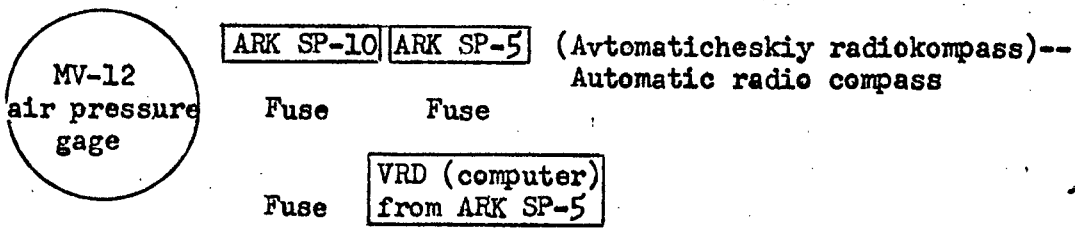
(23) AFA (Aerofotoapparat) -- Aerial Camera



(24) M-2000 pressure gage

(25)



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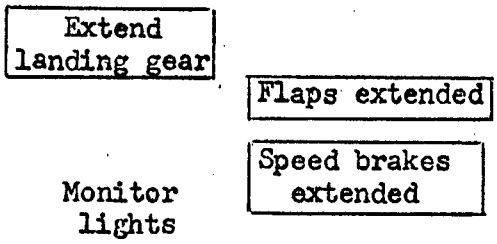

(27) Extend flaps before take-off

(28) (Landing gear) extended

(29) IK-18 oxygen gage

(30) Landing gear retracted

(31) ARU-3V (Avtomaticheskaya regulirovka upravleniya ?) -- Automatic controller

(32) Air speed indicator

(33) AGD-1 (Aviagorizont distantsionnyy) -- Attitude indicator

(34) Variometer

(35) Mach meter

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(36) UGR-4 compass (Indicator of course, magnetic bearing, radio station angles of course, course deviation)

(37) ARK BPRS (Avtomaticheskiy radiokompas. Blizhnaya privodnaya radiostantsiya) Automatic radio compass. Inner marker beacon

(38) KSI (Kursovaya sistema istrebiteley) -- Fighter course indicating system

(39) Altimeter

(40) EUP-53 (Elektricheskiy ukazatel' povorota) -- electrical turn indicator

(41) Tachometer

(42) Fuel flow indicator

(42a) UV-57 altitude indicator

(43) Dangerous altitude

(44) AChKhO clock (Aviatsionnyye chasy khronometricheskiye) -- Aircraft triple-dial clock

(45) Oil pressure gage

(46) UVPD (Ukazatel' vysoty i perepada davleniya) -- Cockpit-altitude and differential-pressure indicator

(47) Temperature gage

(48) Booster Utility

Hydraulic system

(49) Manometer 2EDM-250 (Elektricheskiy distantsionnyy manometer) -- Electrical pressure gage

(50) Pumps

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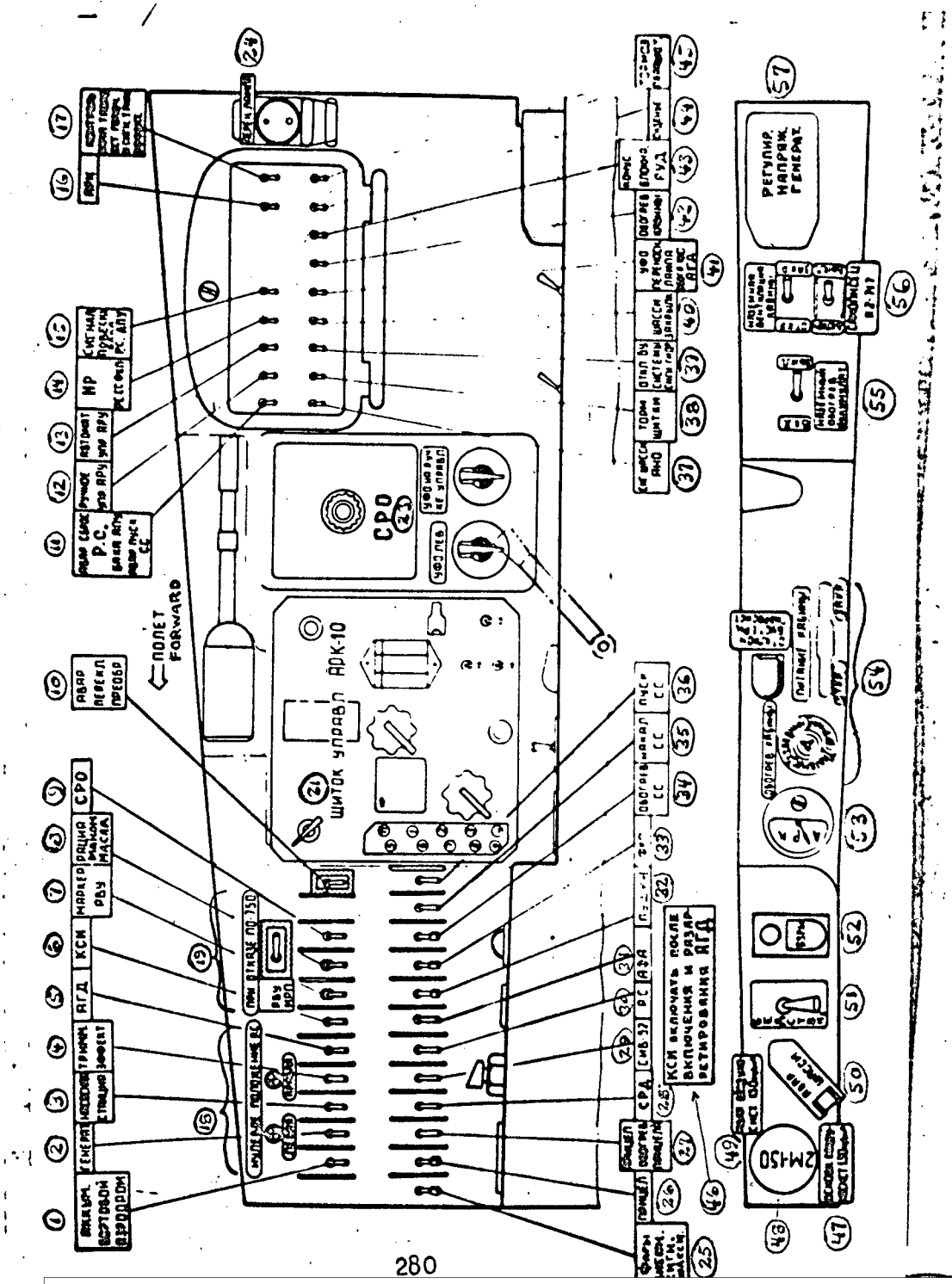

Фиг. 72. Правый пульт.

Figure 72. Right Console

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Figure 72. Right Console

(Key)

(1) Battery - aircraft, external

(2) Generator

(3) Pump unit

(4) Trim effect

(5) AGD (Aviagorizont distantsionnyy) -- Attitude indicator

(6) KSI (Kursovaya sistema istrebiteley) -- Fighter course indicating system

(7) RVU marker (radiovysotomer) -- Radio altimeter marker

(8) Oil pressure gage

(9) SRO (Stantsiya radiolokatsionnogo otvetchika) -- Responder radar

(10) Emergency converter switch

(11) Emergency jettison of rockets, tank, APU; Emergency launch missiles

(12) ARU (Avtomaticheskaya regulirovka upravleniya ?) -- Automatic controller - Manual control

(13) ARU - Automatic control

(14) NR RS SS FKP -- Cannon; rockets; missiles; gun camera

(15) Signal for attachment of tank, rockets, APU

(16) ARK (Avtomaticheskiy radiokompas) -- Automatic Radio Compass

(17) Light register monitor; fuel reserve; trim effect signal

(18) Null position of rockets

Left Right

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(19) [Switch on] in event of failure of PO-750 converter

RVU

MRP (Markernoye radio priyemnoye ustroystvo) -- Marker beacon radio receiver

(21) ARK-10 control panel

(23) SRO

UV lighting - left UV on control stick

(24) Utility light

(25) External landing gear indicator lights

(26) Sight

(27) Sight warm-up; sight

(28) Range-only radar

(29) SIV-52 (Signalizator infrakrasnogo vizira) -- Infrared viewer

(30) Rockets

(31) AFA (Aerofotoapparat) -- Aerial camera

(32) Cannon

(33) Gun camera

(34) Missile warm-up

(35) Missile filament

(36) Missile launch

(37) ANO (Aeronavigatsionnyye ogni) -- Nose landing gear indicator and signal lights

(38) Speed brakes

(39) Booster system and hydraulic indicator switch

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(40) Landing gear; flaps

(41) UV utility light; heating of KKO (Komplekt kislorodnogo oborudovaniya)-- Oxygen equipment unit and AGD

(42) Cabin heat

(43) Cone - RUD (Ruchnoye upravleniye dvigatelya)-- Throttle interlock gear

(44) Seat

(45) Brake parachute

(46) Switch on KSI after switching on and uncaging AGD

(47) Utility air system - 130 kg/cm^2

(48) 2M-150 air pressure gage

(49) Emergency air system - 130 kg/cm^2

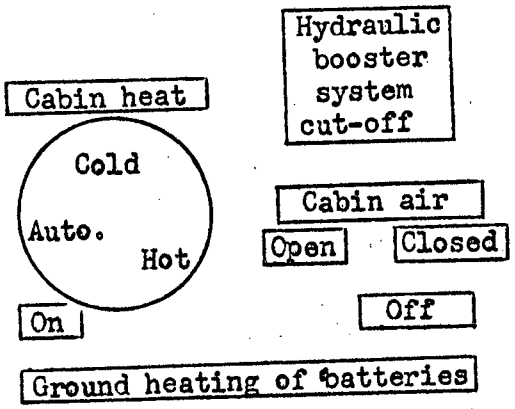
(50) Emergency landing gear extension

(51) Distress

(52) Destruct [?]

(53) ARK

(54)



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(56)

Ground ventilation of cabin		
Open		Closed
On		Off
K2-717 Recorder		

(57) Generator voltage control

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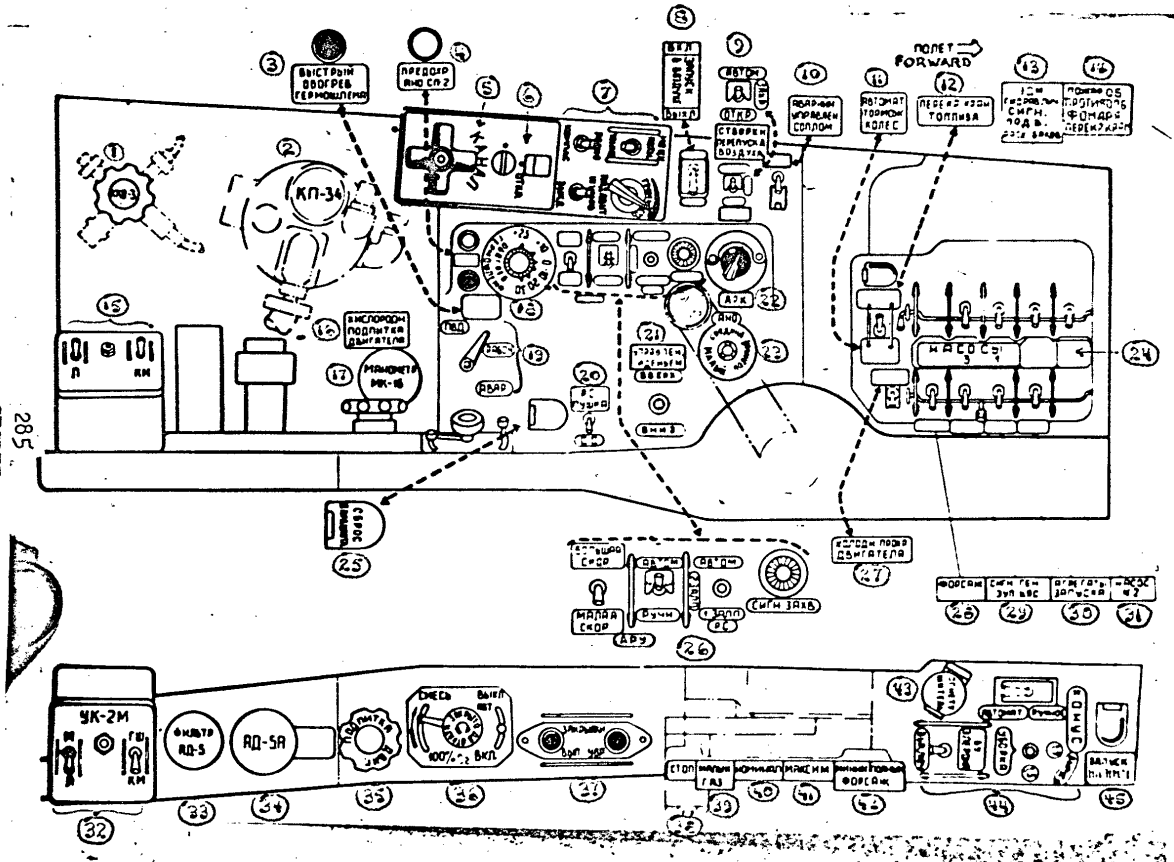

Фиг. 73. Левый пульт.

Figure 73. Left Console

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Figure 73. Left Console

(Key)

(1) KKV-3 (Komplekt kislorodnogo ventilya ?) -- Oxygen valve unit

(2) KP-34 (Kislorodniy pribor) -- Oxygen apparatus

(3) Rapid helmet heating

(4) Fuse for ANO SP-2 (Aeronavigatsionnyye ogni) -- Nose landing gear indicator and signal lights

(5) Channel

(6) Open

(7) Power
Full
Normal rated
Volume
Radio compass
Noise supp. Off

(8) On
Air start
Off

(9) Automat.
Close
Open
Air by-pass valve

(10) Emergency nozzle control

(11) Automatic brakes

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(12) Fuel shut-off valve

(13) EDM (Elektricheskiy distantsionnyy manometer) -- Electrical pressure gage, drop-tank-attached indicator

(14) Canopy de-icing shut-off valve (in case of fire)

(15) L (Letnyy kostyum) -- Flying suit KM (Kislorodnaya maska) -- Oxygen mask

(16) Engine oxygen supply

(17) MK-16 manometer (Oxygen gage)

(18) Helmet heat

(19) PVD (Priyemnik vozdushnoge davleniya) -- Pitot-static head

Operational

Emergency

(20) Rockets
Cannon

Missiles

(21) Seat adjust
Up

Down

(22) ARK (Avtomaticheskiy radiokompas) -- Automatic Radio Compass

(23) ANO

Medium

Dim

Bright

(24) Pumps

(25) Parachute jettison

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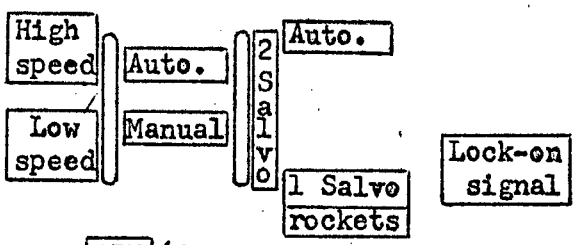
(26) 

ARU (Avtomaticheskaya regulirovka upravleniya ?) -- Automatic controller

(27) Engine cooling blanket(s)

(28) Afterburner

(29) Signal generator; EUP (Elektricheskiy ukazatel' povorota) -- Electrical turn indicator; KYaS (?)

(30) Starting units

(31) Pump No. 2

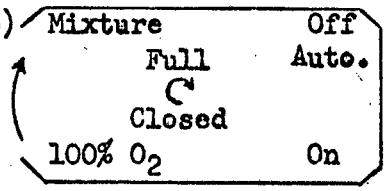
(32)

UK-2M oxygen unit	
M (?)	Helmet
Suit	Ox. mask

(33) AD-5 automatic pressure filter

(34) AD-5A

(35) Engine [oxygen] supply

(36) 

(37) Flaps

Extended Retracted

(38) Off

(39) Idle

(40) Normal rated

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(41) Maximum

(42) Minimum | Full

Afterburner

(43) Fire extinguisher

(44) Cone

Extend

Manual

Auto

Retract

Aileron booster

Off

(45) Ground start

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